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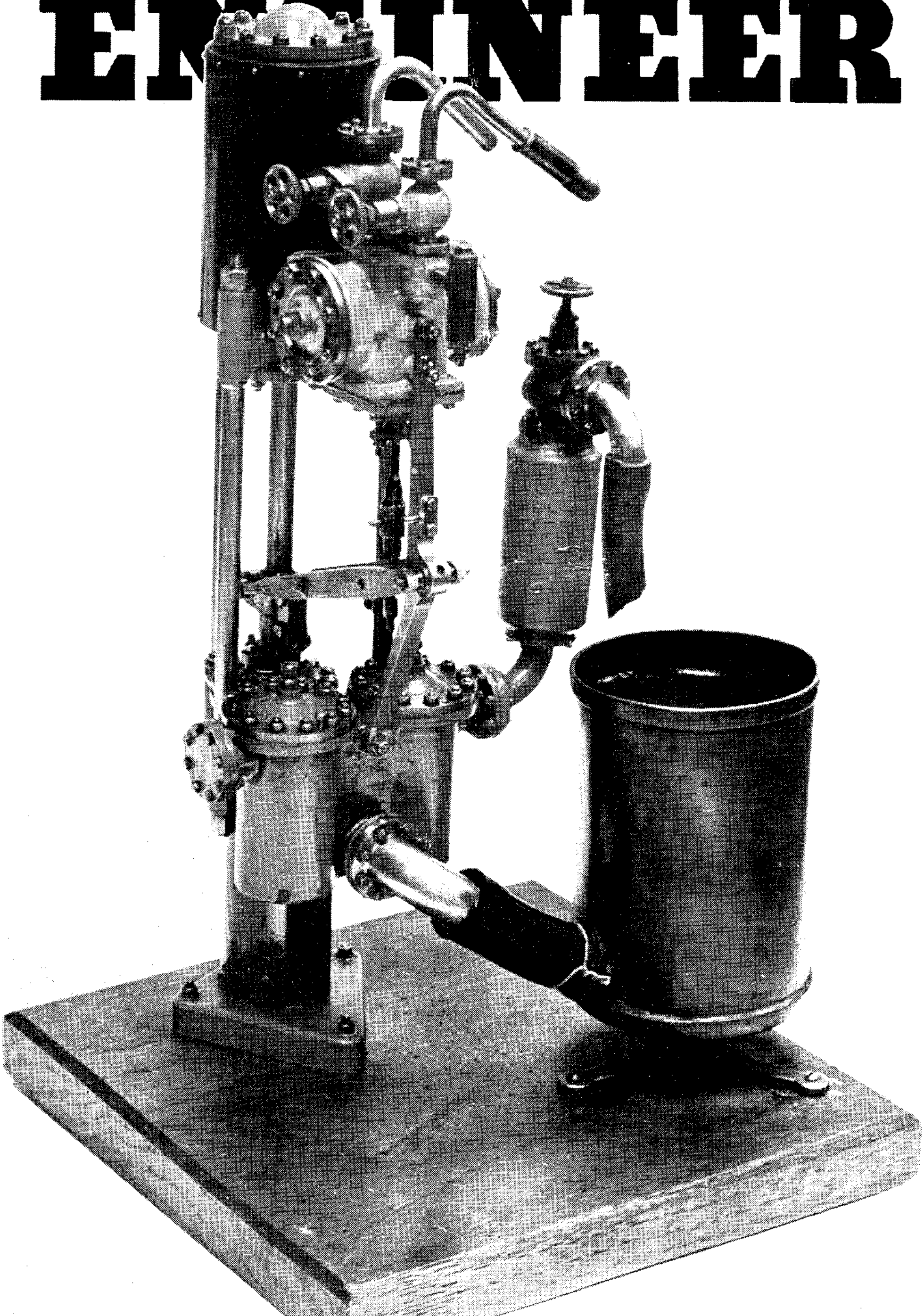
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

8TH NOVEMBER 1951 VOL. 105 NO. 2633

SMOKE RINGS

Our Cover Picture

● THE TYPE of direct-acting steam pump introduced many years ago by Messrs. G. & J. Weir, of Glasgow, has played a very important part in every kind of stationary and marine steam plant, having been employed in almost every role where pumps are required, including feedwater, fire and bilge pumps, air and circulating pumps for condensing plant, and for lubricating and fuel oils. At the recent Engineering and Shipping Exhibition at Olympia, one of the actual Weir pumps which had been installed in the old *Mauretania*, and performed its duty throughout the long and honourable career of this famous liner, was on view. The feature of the Weir pump which accounts perhaps more than any other for its practical success is the "shuttle valve," a form of servo-motor which is controlled by a small pilot slide valve connected by a lever to the main piston-rod, and in turn controls the main slide-valve events. This device has been copied in a more or less modified form by other makers of pumps, but none have excelled the reliability and long life of the original Weir pump. In model form, the valve mechanism can be made to function equally effectively, and our photograph taken at the "M.E." Exhibition, shows the working model Weir pump, constructed to a scale of 1 in. to 1 ft. by Engineer-Commander W. T. Barker, of the S.M.E.E. A full description of this model, with scale drawings, appeared in the issue of the "M.E." dated June 23rd, 1949.

Where is "The Dragon"?

● WRITING FROM Cornwall, Mr. R. Cole wishes to know if any reader living in the Bristol area can give any information about a Burrell compound showman's road locomotive named *The Dragon*. This engine is thought still to belong to Anderton & Rowland, the well-known west of England amusement caterers, and may still be working somewhere in the Bristol area. Mr. Cole adds: "Information as to the whereabouts, condition, etc., or a photograph of this engine will be very welcome, not only to me but to many western readers who knew her in pre-war days."

If any reader can comply with this request, he should get into touch with Mr. Cole, whose address is 2, Barton Terrace, Fraddon, St. Columb, Cornwall.

Incidentally, Mr. Cole mentions that at Redruth there is a fine model of *The Dragon* which he understands will be on view at the next "M.E." Exhibition; we shall look forward to seeing it.

A Showman's Chief Attraction

● WE WERE very interested to receive a cutting from *The World's Fair* containing a letter from Mr. E. A. Lucas, of Salisbury, Wilts ; it states :—

" I am the proud owner of the famous Fowler " Lion," No. 19782, which I bought from Messrs. Anderton and Rowland, of Bristol, to preserve her. To prove how popular the showman's engine still is, I entered her in the carnival procession at Salisbury last month and she was the biggest attraction of the day. The hundreds of interested people who came over to speak to me, all agreed that when the showman took the steamer away from the fair there was little attraction left.

" When we entered the Victoria Park at the end of the carnival, the people just flocked down to where this engine was and they never left till we moved her away home.

" I for one would be only too glad to receive a showman's engine and give it a good home till he wanted her again."

Just in case any reader would like to take advantage of the offer contained in the final paragraph of that letter, we add Mr. Lucas's address, which is 8, The Friary, St. Ann Street, Salisbury, Wilts. Regarding the rest of the letter, however, there is another aspect of the matter, and it is that the decline of the use of the magnificent showman's steam road locomotive was not due to the desire of the showmen ; it was forced on them as an economic necessity by the exigencies of the times. The requirements of the Board of Trade and, later, the Ministry of Transport, the high cost of fuel and maintenance had a great deal to do with it. Still, a few showmen have managed to retain their fine engines and use them, conscious of the fact that the public are always attracted to them more than to anything else.

Another Gas-turbine Locomotive

● IT HAS been known for some time that a second gas-turbine locomotive for British Railways, Western Region, is under construction. The design was worked out jointly by the technical staff at Swindon Works and Metropolitan-Vickers Electrical Co. Ltd., the former being responsible for the body and running gear while the latter company undertook the design and construction of the power unit and electrical transmission.

We learn that the power unit has completed its bench tests at Barton and is now at the Metrovick factory at Trafford Park, Manchester, where it is being installed in the locomotive.

This particular gas-turbine is the first of a new design constructed in this country for railway applications, and has therefore been the subject of a comprehensive series of tests extending over nearly twelve months ; hence the long delay in the delivery of the new locomotive to the railway. We are now expecting to see it on trial within the next few weeks.

The Swiss gas-turbine, No. 18000, after a major repair earlier in the year, has been regularly in traffic during the latter part of the summer. Its daily programme was a strenuous one : 7.30 a.m. down fast passenger train from Paddington to Bristol ; 12 noon up express passenger train from Bristol to Paddington ; 6.35 p.m. fast passenger train to Swindon, and returning to London on a heavy parcels train leaving Swindon at about 10 p.m. This routine was carried out regularly for about three months during which No. 18000 appeared to work well. Since then, she has discontinued the working of passenger trains and is used on fast freight and milk trains ; it seems she will soon have a competitor on her own road.

" Doris " in Difficulties

● WE HAVE received a letter from a reader temporarily resident in Australia, Mr. G. P. Nicholls, of Jandowae, Queensland, who writes :—

" It gives me great pleasure to write to you like this, for I feel that, although we are 13,000 miles apart, I am writing to a friend. Out here, in this particular part of Australia, I am a lone wolf, as regards model engineering, and if it wasn't for a regular supply of THE MODEL ENGINEER from home, I would feel completely lost. When I was in England, I completed *Juliet* for $1\frac{3}{4}$-in. gauge, and out here I am trying to build *Doris* for $3\frac{1}{2}$-in. gauge. But it is a royal battle from beginning to end, as there is a terrible steel shortage, plus living away up in the Bush, where transport isn't all that could be desired ! "

To think of building a small locomotive at all in such circumstances requires model engineering enthusiasm of the right kind, and we sincerely hope that Mr. Nicholls will be able to finish his *Doris* to his satisfaction, especially as he says he hopes to return to England in time for the next " M.E." Exhibition and to have *Doris* there. We shall certainly look for her with more than ordinary interest.

Two Remarkable Records

● THE FOLLOWING story has been extracted from our contemporary, *The Shoe and Leather News* for October 18th last :

" Within the past two years, the Bridge of Weir Leather Co. Ltd. have placed on the ' retired list ' a boiler made of ' Low Moor ' iron which had been in commission for 97 years. It was originally installed in 1852, when the building, which has been their sheepskin tannery since 1902, was a cotton-spinning mill. One reason advanced for the longevity of the boiler is the suitability of the water from the Gryffe river—the amount of scale that formed each year being infinitesimal. It is a fact confirmed by the Boiler Makers' Institute that for the last twenty years of its life, it was the oldest working boiler in the world.

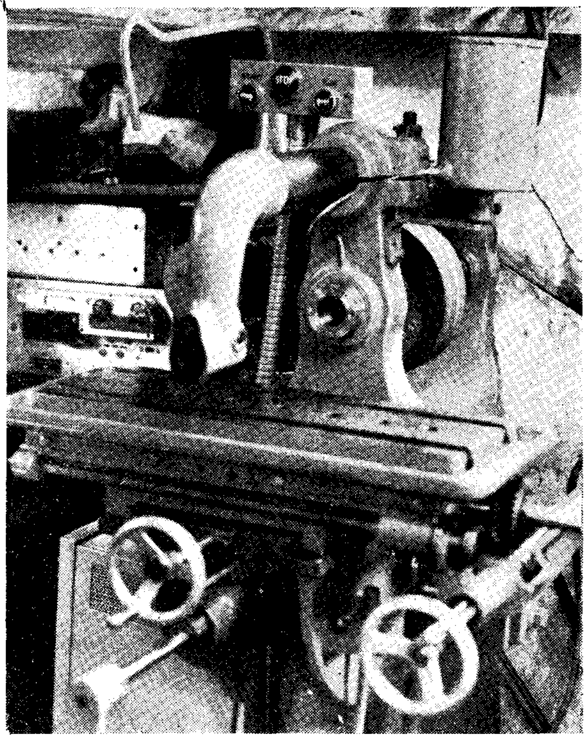
" Associated with the boiler during the latter part of its life was the tannery cat. Born in 1923, the cat spent many hours of each day sitting in front of the boiler—they were, in fact, constant companions. Sad to relate, within a very short time of the boiler ceasing to operate, the cat died, having reached the remarkable age of 26 years. Such longevity on the part of both boiler and cat is quite remarkable and has prompted the question : are not they an all-time record ? "

We are unable to answer the question, but we are quite ready to believe that the answer must be in the affirmative.

REBUILDING A SECOND-HAND MILLER

by E. Sweet

I CONSIDER that much time can be saved when machining parts if separate machines are used for turning, drilling, milling, etc. Very often it takes longer to set up the lathe for milling than it does to do the job. Having come to this conclusion, the problem was to obtain a miller, and not having much cash to spare, an old machine was finally acquired. It is probably an antique among millers, the date of manufacture being approximately 1890, although I have not approached the makers of the machine on this matter. Here follows a record of the overhaul of the machine.



Front view, showing control switch and spindle details

After delivery, which involved transporting the machine, weighing about 4 cwt., through the house (for which I give full credit to the transport contractors), it seemed very big when in my workshop. The machine at this time had cone pulley drive through $2\frac{1}{2}$-in. flat belt, with belt drive, through jockey pulleys, to the feed shaft; this shaft is mounted in a frame which travels up and down with the knee. The spindle ran in bronze cone bearings, with the thrust taken by a bolt at the rear, and the nose had a taper similar to, but slightly larger, than No. 2 Morse; ejection was by drift through cotter holes, and other holes had been drilled to retain the taper. Apart from this, the layout of the machine was as is shown in the photographs.

As I wished to use a modern type "quick-release" spindle nose, with a draw-bolt through the spindle, the diameter at the rear had to be increased, and different arrangements made to take the end thrust. I finally decided to make a new spindle with parallel bearings, the thrusts being taken on flanges at the ends of the journal bearings. Accordingly, a 20 in. length of S.11 steel bar was obtained; this is a 45-ton nickel steel, and the turning was about the biggest job yet tackled on my lathe. The spindle was finally roughed out externally, and the journals polished.

The method I used for machining the bore was to put a plain 17/32 in. diameter hole right through, then, when the spindle was running in the miller, to machine the taper and rest of the spindle nose. I have no fixed steady for my lathe, and so the set-up adopted was as shown in Fig. 1. For drilling, I had long drills of $\frac{5}{16}$ in. and $\frac{1}{2}$ in. diameter, and by drilling from each end I was able to get the hole through. To bring the hole to size, a diamond drill was made as shown in Fig. 2.

I next bored out the existing bronze bearings to fit the spindle. These bearings were then fitted into their housings in the machine. However, on offering up the spindle, I found that the bores were out of line, this in spite of careful truing up when boring them. I consider the cause of this to be either warping of the castings over the years, or that the housings were not in line when first machined; the old taper bronzes had obviously been hand-fitted and accuracy, as machined, would not be necessary. To overcome this difficulty, I scraped the bearings to allow the shaft to enter; this gave about three-quarters contact and without making a new spindle with taper bearings, was the best that I could do. After the spindle had been run in, I clamped the top-slide of my lathe on to the miller table, and using the lathe tools, finish-machined the spindle nose.

As overhead countershaft drive is out of the question in my workshop, I obtained an old car

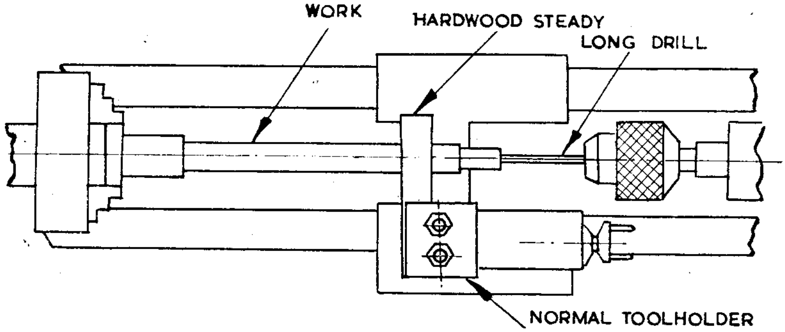


Fig. 1. *Diagram of lathe set-up*

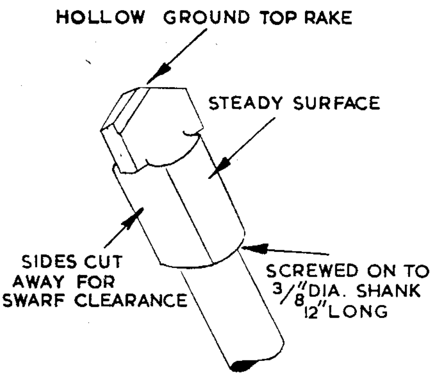


Fig. 2. *Rifle drill-head*

starting current of about 20 A. As I did not want to fit a clutch, something simpler than the usual "Mickey Mouse" starter was considered necessary. I found that the motor could be started on load by including a resistance of 20 ohms in the armature circuit, starting current was then 10 A. I wanted to operate this by push-button control; to do this the start button closes a standard magnetic starter, while the run button closes a relay which shorts out the starting resistor. A reversing switch, considered essential on a miller, was included in the circuit.

All this gear is enclosed in the steel case on the side of the machine, together with the feed motor controls. As I wanted something more flexible than the original feed system, I decided to employ a separate feed motor, and accordingly, I obtained a war surplus hand-driven generator. I made an adaptor, as shown in Fig. 3, to attach this to the gearbox; I believe it is a Vauxhall 14. I mounted this on the side of the miller column, using angle-iron rails. As I wanted slow spindle speeds, the four-groove vee-pulleys fitted in the final drive are necessary to transmit the high torque. Ready machined Fenner vee-pulleys were used at this point, the one on the spindle being fitted with a taper gib key and the one on the gearbox being bolted to the driving flange.

Being on d.c. mains, I obtained a 1½ h.p. d.c. motor. I found that this could be switched direct on the mains, but that it took a

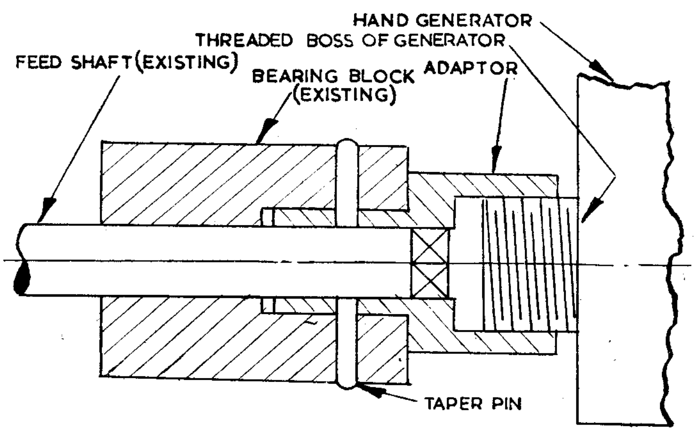
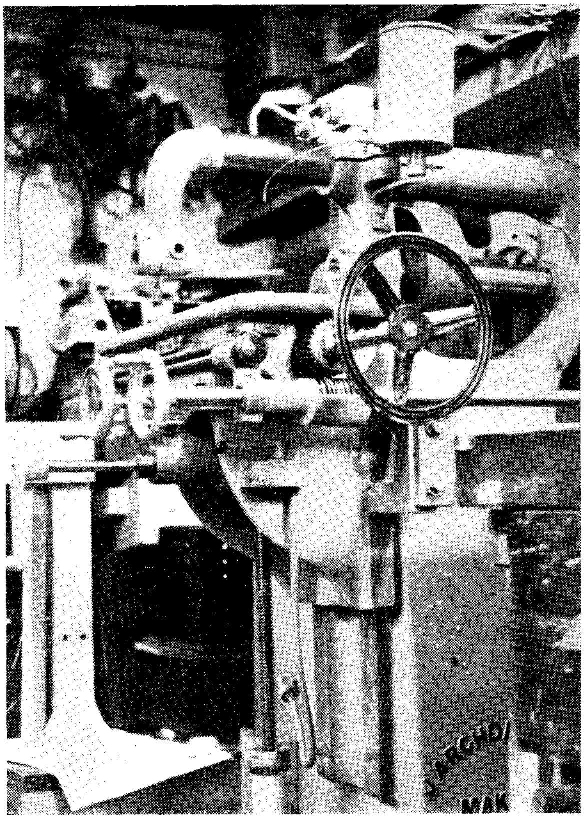


Fig. 3. *Diagram of feed motor fixing*

end of the feed shaft. Axial movement of the feed shaft now engages the square in the output shaft of the gearbox and takes up the drive. I fitted a switch to give either series or series-shunt operation, thus providing two speeds; a reversing switch was also fitted to the feed motor circuit. Feed rates are now approximately ½ in. and 1 in. per minute.

General overhaul work was carried out on the machine, and all slide-ways were trued up by scraping and bedding in. Alignments were checked, and were adjusted for the more important motions of the slides. All leadscrew nuts were renewed, cutting them from bronze bar. They were made as good a fit as possible on the rather badly worn screws. Many other small points had to be attended to, such as providing efficient lubricators for the main bearings, fitting handwheels instead of the original crank handles, and a dripcan was also fitted. The final work of painting was then carried out, and the machine bolted down. A number of items now require to be attended to before the machine can be considered complete; indices must be fitted to the screws, and various arbors must be made. The next step will be to acquire a vice and dividing head.



View showing feed gears and feed reversing switch

For the Bookshelf

Modern Motor Boats and Yachts, by Norman Loveless. Temple Press Limited, Bowling Green Lane, E.C.1. 8s. 6d. net.

With over twenty years' experience of handling a large variety of craft in various corners of the globe, I was able to read Mr. Loveless's book with something of the air of the professional critic. But I found nothing to criticise! That is to say, nothing in the text; the title of the book is a horse of another colour.

Modern Motor Boats and Yachts is, in my opinion, likely to lead to an under-assessment of a book which has no rival as an introductory medium to all aspects of yachts and yachting. By the aid of splendid line drawings and a superb collection of half tones, the author covers his subject with the care and familiarity of the master story-teller, imparting essential knowledge so cunningly that the reader will be unaware that he is being taught.

The many exploded views and lines of various vessels will be of great value to the ship modeller.

—G.W.A.-B.

Modern Motorcycles, by Bertol Osborne. Temple Press Limited, Bowling Green Lane, E.C.1. 8s. 6d. net.

Motorcycles have long been a popular means of transport, and indeed a great number of motorcyclists may be classed as exponents or at least as enthusiasts of the motorcycle. But there are still an even larger number of riders who, for one reason or another, have either evaded or by-passed those historical and technical details which could create for them an intense interest in their chosen vehicle.

The history and development of the motorcycle is intriguingly portrayed in Mr. Osborne's book, which, although written for the Boys' "Power and Speed" Library, is nevertheless worthy of a place on the bookshelf of every motorcyclist. It is well illustrated with line drawings, graphs and half-tone plates, and the text covers every aspect in an easily assimilated style which should appeal to readers of all ages.

CROSS-SLIDE STOPS FOR THE M.L.7

by F. G. Garraway

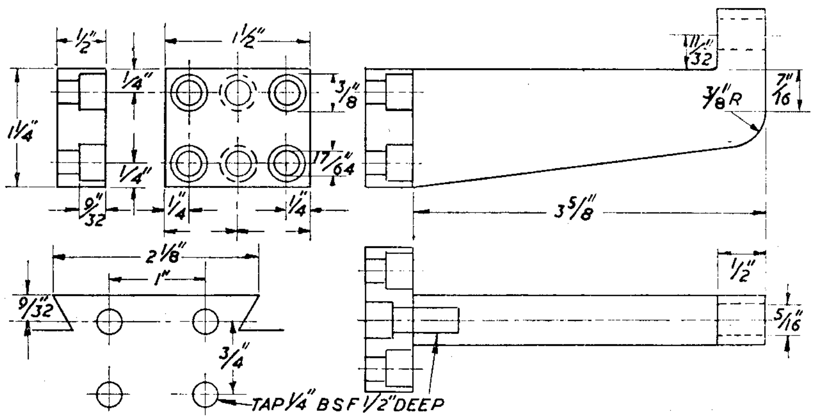
THE model engineering side of my life is nearly always at war with itself. One half wants to press on with the building of my 0-4-0 5-in. gauge locomotive, while the other half has an urge to design and make all kinds of attachments for the lathe. But when I came to the port-cutting stage in the machining of the cylinders, the two halves were reconciled, as I realised that some form of cross-slide stop was essential.

(*d*) The right side is already taken up with gib-screws and, in my case, slide lock-screws.

(*e*) The adjustable stop-lugs are usually frictionally held and are thus never really proof against slipping.

It will be seen that my device obviates these potential troubles.

The slide is quite free of all extra fittings in



The cylinders were held on the cross-slide (port-face to chuck) by a long bolt through the bore with packing interposed to obtain the correct height, the stops being used to obtain uniform length of ports.

The design shown in the sketches will be found easy to make and to have that very necessary "solid" feel in use.

I dislike the usual arrangement in the form of a slotted bar fitted along the edge of the slide, because :—

(*a*) The tee-slot ends are nearly always obstructed to some extent by the slotted bar.

(*b*) When the slide contacts the stop a twisting force is applied to the slide. (I know *your* slide has no slack in its gib-strip, but *some* have !)

(*c*) If the stops are fitted to the headstock side of the slide, I have had experience of swarf finding its way between fixed and moving parts, giving a false stop.
In this position also they are not very accessible for adjustment when the saddle is under the chuck or cutter. In any case, the shelf on this side of the M.L.7 saddle should have a sheet-metal guard screwed to the side of the slide to prevent swarf working under the slide-ways.

places likely to hinder setting-up and machining. The stop-rod is in line with the feed-screw, thus causing no twist or spring of the slide. It is very unlikely that swarf would cause any trouble. It is always accessible for adjustment and cannot slip. In an endeavour to be honest I must admit that it projects some way behind the slide, but what does it obstruct ?

Construction

The base of the stop-arm consists of a piece of mild-steel, $1\frac{1}{2}$ in. × $1\frac{1}{4}$ in. × $\frac{1}{2}$ in., drilled and counterbored for $\frac{1}{4}$ in. B.S.F. Allen screws, as shown. Note that the middle pair of holes is counterbored from the opposite side. The arm itself is also of mild-steel bar, and involves a bit of hacksawing and filing. It could be fabricated from a piece of mild-steel, $3\frac{5}{8}$ in. × $1\frac{1}{4}$ in. × $\frac{1}{2}$ in., with a block $\frac{1}{2}$ in. × $\frac{1}{2}$ in. × $\frac{5}{8}$ in., brazed on. The end in which are tapped the two $\frac{1}{4}$ in. B.S.F. holes must be squared off accurately, or the stop-rod will foul the sides of its hole. When assembling, check carefully for squareness and be sure the two Allen screw heads are well sunk. All six screws are $\frac{1}{4}$-in. B.S.F. × $\frac{5}{8}$ in. long.

When satisfied, stand the arm on its base and drill the lug with a No. 6 drill. The reason for this will become apparent later on. Exact positional accuracy is not of great importance, but squareness

(*Continued on page* 608)

Screw-Cutting Multiple Threads

by E. G. Smith

THERE are occasions where multiple threads with two or more starts can be extremely useful as they serve to provide a quick action without cutting a heavy thread, or alternatively to maintain an effective pitch where the thickness of metal does not allow of cutting a single thread to the desired pitch.

The usual method of cutting multiple threads is to cut the first thread to full depth, then mark the teeth of the change wheels, disengage the quadrant, move the mandrel part of a turn according to the number of starts required, re-engage and cut the second thread, repeating as necessary; not too bad for two starts, but if for instance an 8 start thread is being cut this can be a long and tedious performance, particularly when it comes to those last few fine cuts necessary to obtain a good fit between screw and nut. It may not, however, be realised by the amateur that where he has a certain amount of latitude regarding lead and pitch to be used, by judicious choice of these details the dividing for 2, 4 and 8 start threads may be done from the screw-cutting indicator without touching the change-wheels.

The Screw Cutting Indicator

This article refers generally to any small lathe having a lead-screw of eight threads per inch and in order to cut multiple threads from the screw-cutting indicator it is essential that this should be marked for *every thread* of the lead-screw. The author's own lathe is a Myford ML7, and the Myford screw-cutting indicator as sent out is only marked for every fourth thread; on account of the popularity of this excellent machine no apologies are offered for including in this article details of how a new head was fitted to Myford's indicator (see Fig. 1).

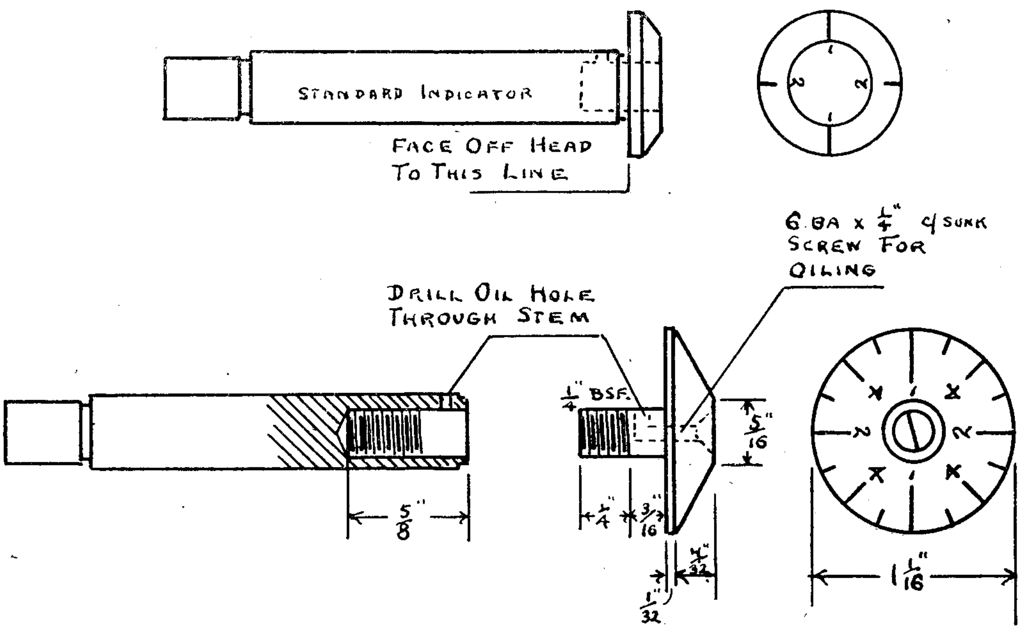


Fig. 1. New head for M.L.7 screwcutting indicator

The stem of the new head is first turned on the end of any odd piece of stock which will finish to the outside diameter of $1\frac{1}{16}$ in. Do any rough turning necessary and cut the thread before parting off at a full $\frac{1}{4}$ in. wide; brass makes a nice head if available. Next, carefully press or drive the worm wheel off the indicator shaft, hold the shaft in the self-centring chuck and face away the head (and oiler) to the line of its back face, then drill down and tap $\frac{1}{4}$-in. B.S.F. as shown. The new head may now be screwed into the shaft, finish turned, drilled, and countersunk for the oil-hole and screw, and then marked out.

If no dividing head is available for markIng out the dial, cut a strip of paper to fit exactly around the chuck body, mark off the strip into 16 equal divisions and fix it around the chuck with selotape; any kind of rough fixed pointer

will then serve to indicate the positions for the 16 marks required, and these are put on the dial with a screw-cutting tool held sideways on the top-slide while the slide is still set for turning the bevelled face. A good marking will be obtained by giving the top-slide handle $3\frac{1}{2}$ turns for the "1" marks, $2\frac{1}{2}$ turns for the "2" marks, $1\frac{1}{2}$ turns for the "4" marks and 1 turn for the remainder. Remove the job from the chuck and drill the oil-hole through the side before unscrewing the head for tapping and numbering with $\frac{1}{16}$ in. stamps. Replace the worm-wheel and the whole is ready for use, with the advantage that it may now be easily dismantled for cleaning by simply unscrewing the head which need only be screwed in hand tight as it does no work.

The foregoing simple improvement is well worth carrying out, if only for ordinary screw-cutting and traversing; in addition, with the leadscrew stationary each mark on the dial represents $\frac{1}{8}$ in. movement of the saddle and the dial may be used as a very convenient and quite accurate means of obtaining depths of bores, recess, etc. from the chuck, and depths of holes, etc., when drilling or milling work mounted on the saddle.

Multiple Thread Data

It is assumed that the reader is familiar with ordinary screw-cutting details and calculations for single threads, but it is also essential that he should understand the meaning of, and difference between *lead* and *pitch* as relating to multiple threads and it might be as well to set out the definitions of these terms before proceeding further. In single threads lead and pitch are the same, but when dealing with multiple threads, lead is the distance travelled by the screw in making one complete turn and pitch is the distance from the centre of any one thread to the centre of *the next thread.* Thus we get the working formulae :

Lead = Pitch × No. of starts.
Pitch = Lead ÷ No. of starts.
No. of starts = Lead ÷ Pitch.

The number of starts which may be cut from the indicator depends on the highest common factor (H.C.F.) of the lead to be cut and the pitch of the leadscrew (both being expressed as threads per inch). With an 8-thread leadscrew single threads may be divided up as follows :—

Highest Common Factor 1, divides into 2, 4, or 8 starts.

Highest Common Factor 2, divides into 2 or 4 starts.

Highest Common Factor 4, divides into 2 starts.

The cutting of multiple start threads from the indicator is quite a simple operation, takes less time than a single thread of the same lead, and with reasonable care in finishing really good fits are easy to obtain. The fundamental difference in the two methods is that when "splitting the change-wheels" each thread is cut to full depth in turn, but when cutting from the indicator all threads are taken down together.

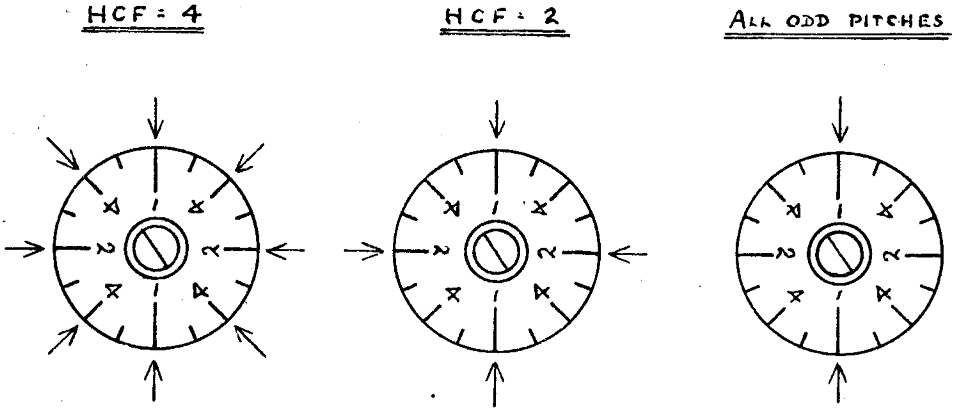


Fig. 2. Positions for engaging leadscrew when cutting single threads with the new indicator

Selecting Lead and Pitch

When preparing to cut a multiple thread, note that the screw-cutting wheels are set up to the lead, while thread depths are calculated from the pitch. For an example, suppose that a screw with a Whitworth form vee-thread is required to give one inch of movement for five turns of the screw, and the thread depth must not exceed 0.035 in. In this case the lead of the screw will be 5 and is obtained by setting up the screw-cutting gears with a 40-tooth driver, a 25-tooth wheel on the leadscrew, and intermediate wheels as required. Then, the lead being an odd number—five—this may be divided into 2, 4, or 8 starts from the indicator, resulting in pitches of 10, 20, or 40. A few simple calculations from the formula depth = 0.64 ÷ t.p.i. inform us that 10, 20 and 40 threads have respective depths of 0.064 in., 0.032 in. and 0.016 in., and we can now decide that a four start thread with a 5 lead and 20 pitch will fulfil the requirements set out above.

Dividing with the Indicator

In cutting single threads with the new indicator, if the number of threads per inch to be cut will divide by the pitch of the leadscrew (8) engage-

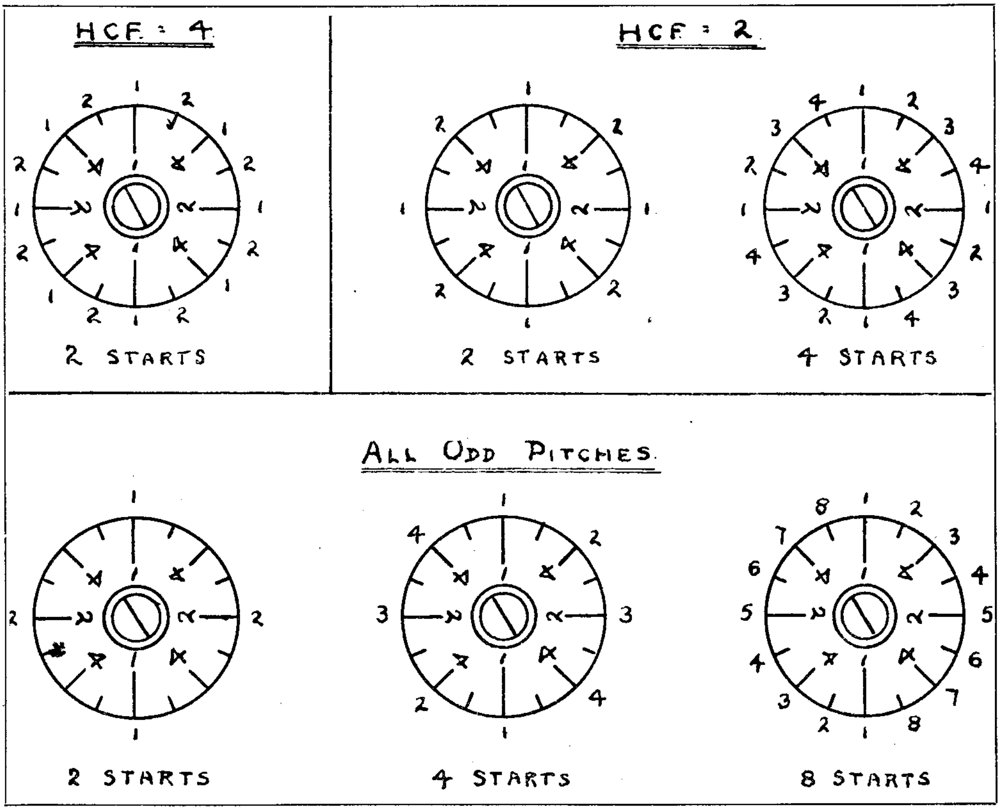


Fig. 3. *Positions for engaging leadscrew for multiple threads. Sequences will reverse when cutting left-hand threads*

ment may be made on any mark and these will not divide into multiple threads from the indicator so we need give no further consideration to this group. If the h.c.f of the t.p.i. to be cut and the t.p.i. of the leadscrew is 4, (i.e., 4, 12, 20, 28, etc.) engage on any mark numbered 1, 2, or 4 ; if the h.c.f. is 2, (i.e., 2, 6, 10, 14, etc.) engage on any mark numbered 1 or 2 ; and if the t.p.i. is an odd number, engage on number 1 only, and use of the indicator for all three groups is shown diagrammatically in Fig. 2.

From Fig. 2 it will be apparent that when cutting a single thread of, for instance, 12-t.p.i. of which the h.c.f. is 4, alternate marks on the dial are used. If the leadscrew is engaged on a "wrong" or intermediate mark the cut will come exactly midway between the threads proper ; therefore, if each cut is repeated alternately on "right" and "wrong" marks the result will be a perfect two start thread having a lead equal to 12 t.p.i. and pitch egual to 24-t.p.i.

In a like manner, when the h.c.f. is 2, either

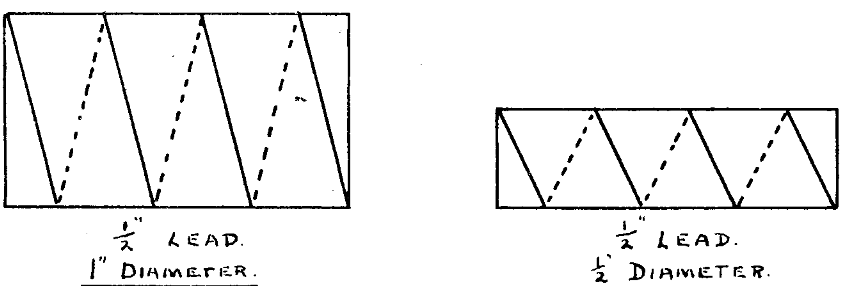


Fig. 4. *Illustrating variation of pitch angle with diameter*

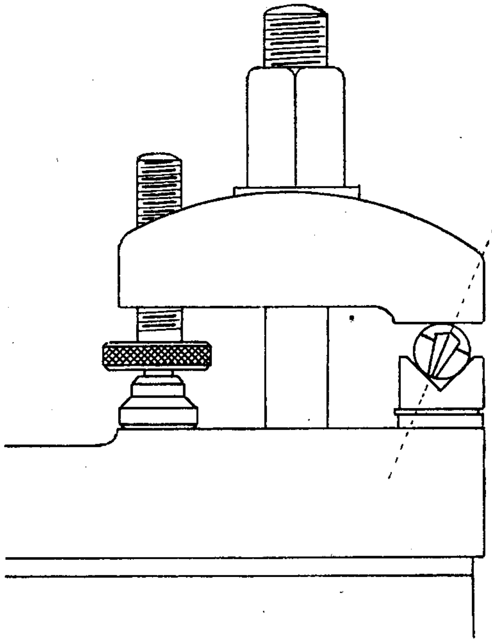


Fig. 5. Setting tool to match pitch angle

2 or 4 starts may be cut, and if the t.p.i. is an odd number either 2, 4 or 8 starts may be cut by using appropriate marks on the indicator, and without touching the change-wheels. Positions for engagement in all cases are shown in Fig. 3, the numbers outside the "dial" showing the order of engagement for the split nut; the illustration is for right-hand threads and direction of rotation will be reversed when cutting left-hand threads. It might be as well to mention here that the fact of the dial covering 2 in. of the lead-screw may be completely ignored; it does not matter which half of the dial comes to the datum line so long as the corresponding mark on the dial is used.

Tools for Multiple Threads

One of the problems arising in cutting multiple threads is that the pitch angle of the thread will probably be too great to permit use of the ordinary screw-cutting tool, and this angle will vary with the diameter of the screw as well as with the lead of the thread as illustrated by Fig. 4.

A good method of dealing with this problem is to grind a screw-cutting tool from a $\frac{5}{16}$ in. or $\frac{3}{8}$ in. round high speed tool bit; if this tool is then held in a vee-block as Fig. 5, it may be set to give correct side clearances for any thread, either right or left-hand. Internal threads may be dealt with in the same way if the bore is large enough to admit a boring bar carrying a round tool; otherwise an ordinary internal screw-cutting tool must be ground to suit the pitch angle of the thread being cut.

An experienced worker will be able to judge the pitch angle near enough for practical purposes, but if in doubt, set out the angle on a piece of thin cardboard and cut a template to which the tool may be set.

Cross-Slide Stops for the M.L.7

(*Continued from page* 604)

of the hole with the base is essential. The stop-rod is a 7 in. length of $\frac{1}{4}$-in. B.S.F. screwed rod. Five nuts to fit are also needed. These must run truly on the rod. Some nuts are tapped very much out of truth, and if used, one side will contact the stop-lug first. Continuing pressure will then spring the rod, giving a non-positive stop. Do not be tempted to use any form of friction-nut. If you are in a hurry to make a large alteration to slide-travel, you will soon realise why not!

Assembly

This, I am afraid, means removing the saddle, but it only has to be done once anyway, and it is a good opportunity to give the undersides a thorough clean.

The stop-arm base should be clamped in the position shown, the four holes spotted 17/64 in., opened out to No. 6, and tapped $\frac{1}{4}$-in. B.S.F. $\times$ $\frac{1}{2}$ in. deep. Screw the arm to the saddle and feed the slide right forward. Position the saddle on the driller bed with the stop-lug at the top, and using the lug as a jig, drill the rear of the slide No. 6. Then open out the stop-lug hole only, to the shank-diameter of your $\frac{1}{4}$-in. B.S.F. tap, use the lug again as a jig and tap $\frac{1}{4}$ in. B.S.F. Lastly, open out the stop-lug hole to $\frac{5}{16}$ in.

All this may seem very involved, but will ensure the hole in the rear of the slide being tapped squarely.

The stop-rod is next screwed into the slide and lock-nutted, with two nuts each side of the lug. The rod should now pass through the lug without touching over its entire travel.

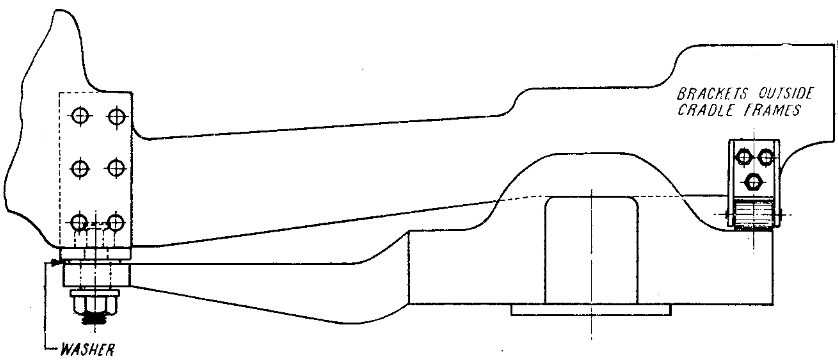
The alternative and neater method of construction is to omit the two central holes in the base and to mill a $\frac{1}{4}$ in. wide slot instead. Then to braze in a piece of $\frac{1}{4}$-in. mild-steel plate for the stop-arm, with a piece of $\frac{1}{2}$ in. $\times$ $\frac{1}{2}$ in. mild-steel brazed to the end of that as the stop-lug. This is the method I should have used myself had I not been temporarily deprived of miller and oxy-acetylene.

"Britannia" in $3\frac{1}{2}$-in. Gauge

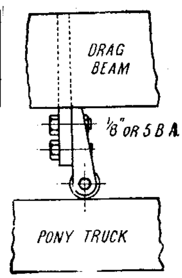
How to Erect the Pony Truck

by "L.B.S.C."

THE erection of the pony truck is a simple job, the only actual attachment to the main frames being by the king-pin, which is fitted to the underside of the rear cross-stay, at the trailing end of the frame assembly. On the full-sized engines, the load on the narrow frame extension carrying the firebox, is transferred to the pony-truck frame by an arrangement of slides ; but I have simplified this, and substituted a couple of brackets carrying rollers, which bear on the rear member of the pony truck frame direct. The principal reason for this, is to ensure absolutely free side movement. On many weeny "main lines," we often have to use curves of colliery-siding radius, on account of restricted trackage space ; and very few—if any !—drivers of little locomotives are content to take these curves at an equivalent speed to that of the colliery shunting engine. In addition to the minimum-radius curve query, some correspondents have piled on the agony, in a manner of speaking, by asking what is the maximum safe speed to run around them ! My own experiments have proved that, unless a pony truck on a long engine has free side movement, the engine will either spread the rails, or come off (sometimes both, as she slips down between the spread rails) if the driver "exceeds the limit" on the curves. Hence the roller arrangement, which allows the pony truck to carry its share of the weight, yet leaves it free to move from side to side. For the benefit of our beginner friends, I had better mention that there is a vast amount of difference between a trailing pony truck and a leading bogie ; if the latter is too free, the engine will "nose" from side to side on a straight piece of line, which is why I specify the flat bolster and rubbing plate. Well, let's get on with the job.



How to erect pony truck



End view of bracket

King-Pin

The king-pin is turned from $\frac{5}{16}$-in. round mild-steel, or silver-steel if you like, to the dimensions shown in the detail illustration; just a simple exercise in plain turning and screwing, with the bit of rod held in the three-jaw. The longer end goes through the hole in the back frame stay, and is nutted on top. You will have to make the nuts, from $\frac{3}{8}$-in. hexagon rod (either steel or brass will do) as $\frac{1}{4}$ in. $\times$ 40 nuts are not made commercially. Two washers are needed, one drilled $\frac{5}{16}$ in. and one $\frac{1}{4}$ in., a bare $\frac{1}{16}$ in. thick, which may also be brass or steel.

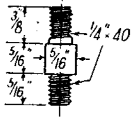
If the pony truck frame is cast in bronze or iron, drill a $\frac{5}{16}$-in. clearing hole in the boss at the end of the triangular part. If an aluminium casting is used, drill the hole $\frac{7}{16}$ in. and squeeze in a bronze bush with a $\frac{1}{16}$-in. flange at the bottom. Note, if this is done, the plain part of the king-pin will have to be made $\frac{3}{8}$ in. long, instead of $\frac{5}{16}$ in. as shown. Then erect as shown, with the larger-holed washer between the pony truck and the stay. The pony truck doesn't need to be too tight on the pin ; a little freedom is an advantage here, to ensure that the weight is properly transferred through the rolllers.

Now temporarily fix the axleboxes in running position, by jamming a piece of $\frac{1}{8}$-in. rod between the bottom of the axlebox, and the hornstay. Stand the whole chassis on something level ; the lathe bed would do, if long enough. It is a good wheeze to rig up a temporary stand by mounting two bits of rail on a piece of board about 6 in. wide, and as long as the engine. The board should be flat and true ; and if rail isn't available, square or rectangular steel will do just as well. This makes a nobby stand on which to

erect the engine. With the chassis on the flat surface, see if the top of the triangular part of the pony truck is level, when the boss is pressed up against the stay. If not, change the washer for a thicker or thinner one, as the case may be; but as long as it looks level to the eye, "mike measurements" are not necessary. There should be about 1/64 in. up-and-down movement.

Roller Brackets

A piece of brass or steel channel, $\frac{1}{2}$ in. × $\frac{1}{4}$ in. × $\frac{1}{16}$ in., and about 2 in. long, will make both the roller brackets; but if this isn't available, the channel can be bent up in two wags of a dog's



Pony king-pin

tail, from a piece of 16-gauge sheet brass or steel. Bend the brackets separately. Cut two pieces 1 in. long and $\frac{7}{8}$ in. wide, and bend up $\frac{1}{4}$ in. of one of the shorter sides to a right-angle, in the bench vice. Drop a short piece of $\frac{3}{8}$-in. square rod in the angle, grip the lot in the vice jaws, and hammer down the projecting edge on to the square rod. My invaluable Diacro bending brake does jobs like this, quicker than I can write about them—honest truth and no kidding! File the sides of the channels to the shape and dimensions shown, and drill the screw-holes in the back; then mark off and drill the holes for the roller spindle. It would be best to drill the holes at each side separately, as the rollers should be quite true and square (square rollers, begob, says Pat) with the bracket. Use No. 34 drill, then poke a $\frac{1}{8}$-in. reamer through both of them at once.

The rollers are made from $\frac{5}{16}$-in. round silver-steel. Chuck truly in three-jaw; if the chuck is "out," a bit of foil or paper between the steel and the offending jaw, should teach it better manners. Face the end, centre, and drill down about $\frac{7}{16}$ in. depth with No. 30 drill. Part off at a full $\frac{3}{8}$ in. from the end; then ditto repeato the operation. Chuck each in three-jaw, parted end outwards, and face off until the roller will just slip nicely between the sides of the channel. Cut two pieces of $\frac{1}{8}$-in. round silver-steel, squaring off the ends so that the pieces are $\frac{9}{16}$ in. long. Put the rollers in place, poke the pins through the lot, and slightly rivet over the ends of the pins, taking care not to pinch the rollers, which must be quite free.

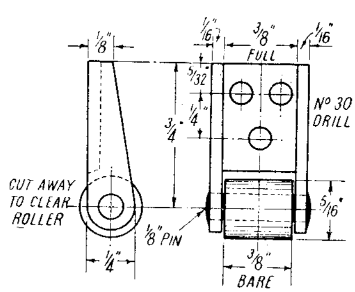
How to Fit the Brackets

Stand the chassis on the flat surface, or stand, once more, making certain that the axleboxes of the pony truck are still jammed up in running position; then put one of the brackets in position, as shown in the illustration of the pony truck erected. The bracket should be on the outside of the narrow frame; and the roller should rest, fair and square, on the rear cross-member of the truck direct, if same is iron or bronze. If an aluminium casting is used, cut a piece of 16-gauge steel, $\frac{3}{8}$ in. wide, and the full length of the cross-member; or better still, if the material is available, use a piece of bright steel strip $\frac{3}{8}$ in. × $\frac{1}{16}$ in. Put this on top of the aluminium, and secure it by four or six 3/32-in. or 7-B.A. countersunk screws. This will provide a practically non-wearing rail for the rollers to run on.

Hold the bracket temporarily in position by aid of a toolmaker's cramp placed over bracket and frame; poke the No. 30 drill through the holes in the bracket, carry on right through the frame, file off any burrs, and secure the bracket to the frame by three $\frac{1}{8}$-in. or 5-B.A. nuts and bolts, or by pieces of $\frac{1}{8}$-in. silver-steel screwed and nutted at both ends. With a spot of oil on the roller-pins and the king-pin, the pony truck should move from side to side with perfect freedom, on any ordinary curve, whilst carrying its maximum load. This will be pretty considerable, when the engine is completed. Inspector Meticulous will probably want to know where the stops are, for preventing too much side movement, and argue that the wheels can touch the frames if the pony truck swings too far over. All I need reply to that is, that if your curves are sharp enough to cause the pony wheels to touch the frame, you don't need a *Britannia* engine at all! One with a wheel-base about as long as *Tich's* would be far more suitable for such a road.

Engine Buffers

By the good rights, the next item on the agenda should be the cylinders; but it isn't advisable to start them in the middle of an instalment, and anyway I haven't finished the drawings yet, as it takes me nearly as long to make the drawings, as it does to make the actual cylinders. The directors of the firm of Messrs. Theory, Orthodox & Co. haven't to this day fathomed how I "do the job backwards," in a manner of speaking; build the engine first, and make the drawings

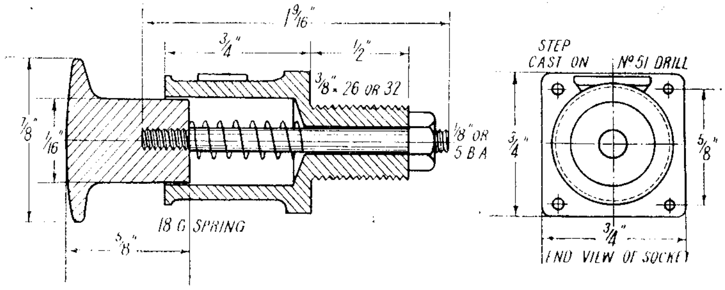


Roller bracket

afterwards—and I don't hail from the little green island where the shamrock grows, either! Still, the engines never fail to do the job, which is more than can be claimed by designers pure and simple, past and present. My correspondence tells many a tale of woe. However, to fill in the time, *Britannia* builders can make the buffers and couplings, details of which are given here. In case anybody chips in that I might

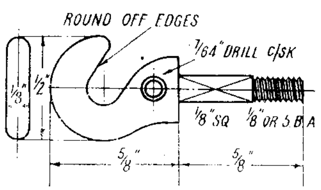
have included the brake gear, I always believe in making certain that a locomotive can GO all right, before making provision for *stopping* it—nuff sed !

Castings should be available for the buffer sockets. As the full-size Class 7's have a step on the socket, I have shown one in the drawing ; but it prevents the outside of the socket being turned, and I'm not putting any steps on the buffer sockets of my own engine, as they are turned from rod material, with separate square flanges made from $\frac{1}{8}$-in. brass sheet. I could, of course, silver-solder steps on turned sockets—so can any reader who so desires—but I'd rather see them without, until such time as we get dwarf drivers and firemen who would find them useful.



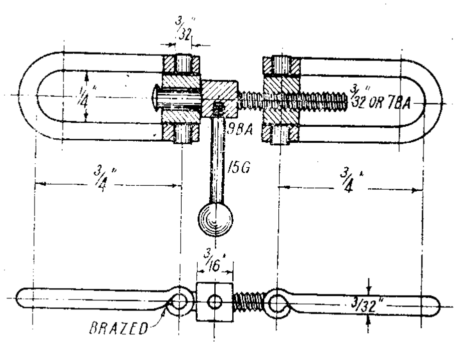
Engine buffer

If castings are used, chuck in four-jaw by the square flange, setting the spigot to run truly ; face the end of the spigot, turn the spigot itself to $\frac{3}{8}$ in. diameter, and face off the square flange. Screw the spigot $\frac{3}{8}$ in. × 26 or 32. Re-chuck the other way around, holding the spigot in a tapped bush held in the three-jaw. Face the end, centre, drill right through with No. 30 drill, and open out to $\frac{5}{8}$ in. depth with a $\frac{7}{16}$ in. drill. The outside can be cleaned up with a file ; just remove any roughness. A posh finish is not required, as the sockets are painted. If the sockets are made from rod material, use a piece of $\frac{11}{16}$-in. or $\frac{3}{4}$-in. round rod $1\frac{1}{4}$ in. long. Chuck in three-jaw, turn and screw the spigot, making it $\frac{1}{8}$ in. longer. Re-chuck in a tapped bush, and proceed as above ; in addition, turn the outside to the outline shown. Cut the flange from $\frac{1}{8}$-in. plate (steel or brass, as you fancy) and drill a $\frac{3}{8}$-in. hole in the middle. The flange may be slipped over the spigot, and silver-soldered, if you care to take the trouble, but it isn't really necessary, as it is clamped tightly against the buffer beam, when the nut at the back is tightened up. The nuts are made from $\frac{1}{2}$-in. hexagon brass or steel rod ; or small commercial Whitworth nuts may be used, if they are drilled out and retapped with the necessary fine thread. Nuts with the original threads stripped, come in all right for job like this, says Hector Mc. Goldberg.



Drawhook

The buffer heads are turned from $\frac{7}{8}$-in. round steel rod, another simple job needing no detailing. It cheered up our old pal Bro. Hyphen no end, when he heard that I had inadvertently turned some out of rustless steel ; but at the same time it isn't a bad wheeze, if you happen to be one of those unfortunate folk who leave rusty marks on any bright steel they have occasion to handle. I know one enthusiastic locomotive builder who rusts up everything he touches, even his bunch of keys and pocket knife, and he's pretty sore about it. Well, it's just one of Nature's tricks ; for my own part I'm lucky, for everything I use, keeps bright. The buffer spindles are made from $\frac{1}{8}$-in. round silver-steel, plus commercial nuts ; and the springs are wound up from 18-gauge



Screw couplings

tinned steel wire. The assembly is shown in the drawings ; the buffers are attached to the beam by nuts on the spigots. For appearance sake, four $\frac{1}{16}$-in. or 10-B.A. hexagon headed screws may be put through the holes in the flange, into tapped holes in the buffer beam ; or the screws

may be dummies, just poked through the holes and riveted into countersinks at the back.

Drawhook and Couplings

The drawhook is filed up from ⅛-in. steel plate, all dimensions being given in the illustration. Don't forget to round off all sharp corners, same as in full size, to avoid cutting the coupling links of the cars. The screw coupling is made in the same manner as fully detailed for other 3½-in. gauge engines described in these notes, so there is no need to repeat the whole ritual, especially as the illustrations are practically self-explanatory. The shackles are made from 3/32-in. round steel, or nickel-bronze, the ends being filed half away and bent into loops, which are brazed or silver-soldered. If you accidentally fill up the eyes, just poke a No. 40 drill through. The swivels are turned from 3/16-in. round rod, likewise the screw, the plain end of which should be an easy fit in the hole in the swivel in the shackle attached to the drawhook. Beginners shouldn't forget to put this shackle through the hole in the draw-hook before bending the loops, otherwise they won't be able to get them through afterwards! Many good folk who were familiar with the detail of the old L.B. & S.C. Ry. engines, used to wonder how on earth the shackle was fitted to the drawhook, as the eyes of the shackle were much bigger than the hole in the hook; but it was just a trick of the old blacksmith at Brighton Works. Many modern engines have a slot in the drawhook instead of a plain hole, but the hook isn't as strong as a "holey" one, for obvious reasons, though it allows the shackle to be dropped into place after it is formed to shape.

The shackles may easily be sprung over the turned ends of the swivels. The plain end of the screw is riveted over just sufficiently to prevent it coming out of the swivel, yet allowing it to turn easily. The centre part is drilled No. 53 and tapped 9 B.A. for the stem of the ball, which is made from 15-gauge spoke wire; the ball is turned from brass or steel, and there is no need to be finicky about it being exactly spherical, as the full-sized ones are just stampings, and not round at all, usually having a flat on each side. Sometimes the ball stems are jointed, but that is a refinement not needed on this job. Make two couplings and draw-hooks while you are at it, and one will then be ready for the tender. The complete gadget is attached to the buffer-beam by putting it through the square hole in same, putting an 18-gauge spring on the shank, and securing it with a commercial nut and washer.

Tail Lamp

Up to the time of writing, I have received goodness knows how many letters asking for advance details of the boiler for *Britannia*, also material required for the tender body and other parts, the querists being afraid they won't be able to get the necessary metal when the notes appear. I cannot give a list of the stuff required, for the simple reason that I don't know myself, until I come to actually making the parts. However, as a guide to those searching for boiler requirements, the boiler of *Britannia* is practically the same size as that which I specified for *Pamela*; and if they obtain a blueprint of *Pamela's* boiler from the "M.E." offices, it may be used as a general "material" guide for *Britannia*.

Fitting Loco Coupling-Rods

FURTHER to my notes on quartering locomotive crankpins, perhaps this way of locating the coupling-rod holes may appeal to brother locomotive men. Incidentally, it's very well worth while using for the eccentric-rod holes in the Walschaerts gear.

With wheels *in situ* in frames, block the axle-boxes up to running position, as described often by our worthy guide, "L.B.S.C." and, with vernier gauge measure over the pins carefully at the "3 o'clock" and "9 o'clock" positions—easy enough to tell by the feel of the gauge. From this measurement deduct half of the pin diameters, and then *add* half of clearance of leading or trailing bush as the case may be. We then have the rod hole centres. Mount rod on vertical slide or angle-plate on cross-slide dead square, and from headstock, drill and ream first hole. Turn up a "button" a firm push fit for the hole, and insert. Move cross-slide and/or vertical slide or angle-plate, and locate for the other hole by the gauge over this "button" any any suitable true running stub in chuck, making the necessary allowance for the two jig buttons, lock up the cross-slide, and carefully centre drill, pilot drill, and follow up with succession of drills to reaming size. This hole should then be as near as no matter to where it ought to be. Those with adjustable boring heads are in clover here—I've been *going* to make one up ever since the war!

In the case of jointed rods, do as above for the first pair of holes in the solid rod, drill and ream for the joint pin, fit same tightly, line up the jointed rod, and finish the trailing bush hole as above, locating, of course, from a "button" in the driving pin hole. It's surprising how the actual axle centres do deviate from "the words and music" in spite of due care, and this way takes care of that. Incidenteally, I'm now wondering how I did so long without this vernier gauge (£3, *ex*-W.D., 10 in. capacity), as it certainly shows up a few home truths about one's workmanship! Do each pair of holes *individually*, so that it is a match for its own pair of axle centres; it's well worth the little extra trouble I can assure you.—T. P. ARNOTT.

Elements of Camera Design and Construction

by H. Arthur Clues

THE first thing we should ask ourselves before commencing to design a camera is : " What do we want it to do ? " For the majority of readers of this journal the reply will be : " To photograph our models, both in part and as a whole, to photograph interesting lathe set-ups and to keep a pictorial record of work being done. In other words, we need a camera for general workshop photography."

Secondly, we must decide whether we are going to design for maximum efficiency or if we are prepared to make a compromise for other considerations such as compactness or portability. Those of you who have valiantly attempted to photograph close-ups with your folding pocket cameras must certainly know to what degree this inefficiency can attain when the prime factor of the design is that the camera must go in the waistcoat pocket !

Conclusions

All right then, we will design for efficiency ! Getting down more to details of the jobs we shall want our camera to do, we can come to a number of conclusions.

First, we want to photograph small objects only a few inches in length. This means that a long extension is a " must " Double extension will give us an image up to the same size as the object ; an even longer extension will enable a magnified image to be obtained. A long focal length lens is an advantage, as it enables a better perspective to be obtained, but it is not essential.

Secondly, we wish to fill the negative with the image and it must be dead sharp *all over*. Well, at such short distances we cannot expect the stops to do all the work—it's too much !—so we must use another method. This is done by using a swinging and tilting lens panel. By swinging and/or tilting the lens, the plane of sharp focus can be brought into line with the main plane or planes of the object—result—pin point definition all over.

Thirdly, we want to photograph an object from above or below and yet leave the verticals vertical. To do this we need a rising and falling front (a cross-front gives the same effect in a horizontal position).

Fourthly, we might want to photograph something full on and yet the surroundings do not permit setting up a camera in a frontal position in which case we must work from a little to one side. This means we need a swinging and tilting back.

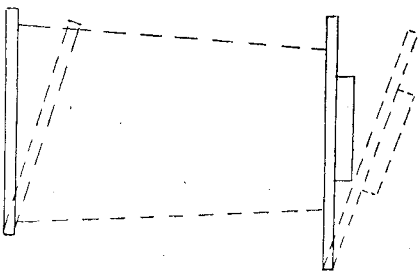


Fig. 1

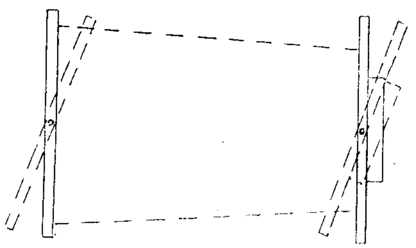


Fig. 2

Well, looking back so far, there is obviously only one type of camera that can do all that—the much maligned, often despised, but nevertheless faithful old stand camera.

Wild Talk

Before proceeding any further, I would like to clear up a few points regarding these movements. There is often a lot of wild talk about rising fronts in particular and all movements in general being used to " correct perspective." In actual fact, neither the rising front or swinging lens has anything to do with perspective. Perspective is *controlled* solely by the movement of the back, and it can hardly be said that it *corrects* perspective unless it is deliberately made to distort it in the first place.

If the back is vertical (as it normally should be) then all vertical lines will be vertical on the negative, and the violence or otherwise of the perspective will depend solely on the nearness of the camera to the object. The rising and cross-front is used solely for positioning the image on the negative. As already explained, the swinging and tilting lens is used for the express purpose of getting the negative sharp all over.

Having decided on the type of camera best suited to our needs, let us look into the methods of obtaining these movements.

Regarding the tilts on both lens panel and back, one method is to hinge both these parts, as shown diagrammatically in Fig. 1. This, to my mind,

is not a very satisfactory method, as the distance between lens and plate varies with the degree of tilt, necessitating constant refocusing. Also, it will be seen that the centre of both lens and back is displaced with consequent movement of image, which means that the camera position must be altered. A far better method is shown in Fig. 2 in which case both movements are

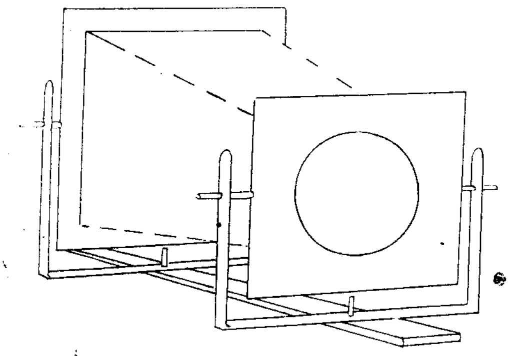


Fig. 3

pivoted from their respective centres with no further adjustments. These same remarks apply to "swings" which are, of course, merely "tilts" in a horizontal direction. Fig. 3 shows how this can be accomplished in practice.

With regard to rising and cross fronts, it is in theory best to be able to make these movements without moving the back of the camera, that is by having the lens panel sliding up and down and sideways in grooves, as shown in Fig. 4. In practice, however, this severely restricts the amount of rise or cross that can be obtained unless one employs a very large front, very large bellows, and consequently a very large camera. It is, therefore, more practicable with this type of camera to obtain these movements by the method shown in Fig. 5.

Suitability of Lens

Before dealing with practical methods of construction and the points of design to watch, I think it would be best to deal with the suitability of a lens for, after all, the lens is a very essential part of the camera and will have a bearing on its design. We can dismiss such types as single meniscus lenses as being too primitive to warrant further consideration. Some correspondents in THE MODEL ENGINEER Practical Letters, have suggested the use of a Rapid Rectilinear or R.R. lens as they are popularly called. Well, they are certainly cheap and easily obtained, so let us examine them further.

An R.R. lens suffers from a number of aberrations to a greater degree than a modern anastigmat. The correction for spherical aberration limits the lens to a maximum aperture of about f. 8. Due to the presence of astigmatism and curvature of field, the definition falls off rapidly away from the centre of the field. This means that although the definition is fairly good in the centre of field, the lens will not cover a very wide angle. Now when using movements on a camera, it will readily be seen that the edge of the field of the lens is used to a great degree. This then rules out the R.R. lens as a general purpose objective.

This leaves us with the anastigmat lens as the only possible choice. Anestigmat lenses vary tremendously in price, so it might be as well to examine just why this is and to see if a suitable good quality lens exists in the price range we are prepared to pay.

Lens Price Factors

The main factors which influence the original price of a lens are (1) complication of construction and degree of precision of workmanship. (2) Maximum aperture. (3) Focal length. All these factors are interconnected to a certain degree, but it does not necessary follow that a grade 1 lens of big aperture and long focal length, although the most expensive, will give any better definition than a grade 1 lens of smaller maximum aperture and shorter focal length at an equivalent stop. In designing a lens of large aperture, a much more complicated construction is called for and even then some sacrifice of definition at small apertures is made in order to be able to obtain a reasonable degree of definition throughout the whole range of stops. It is a fact that some f. 4.5 lenses do not give quite such good definition as a simpler f. 11 lens when both are used at apertures round f. 16.

As we do not need to give exposures of less than several seconds, a wide aperture lens would be a shear waste of money, unless, of course, we also intend using the same lens on another camera for higher speed work.

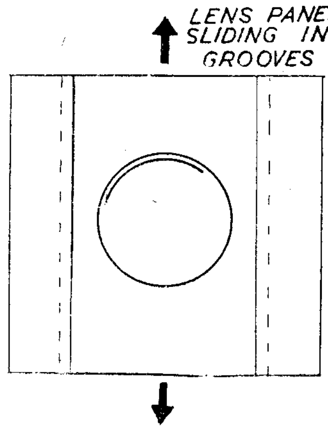


Fig. 4

As regards focal length, this is connected to the size of plate we intend using. To be able to use a short focal length lens we shall need a small plate (I am, of course, referring to general procedure and not to wide angle work, when the reverse is true).

The smallest size plate commercially obtainable in this country measures $3\frac{1}{2}$ in. × $2\frac{1}{2}$ in. and a lens of from 9 cm. to 12 cm. ($3\frac{1}{2}$ in. to $4\frac{3}{4}$ in. approximate) focal length is suitable.

We now have sufficient information to make a start on the actual design of our camera. Briefly, we need a mono-rail construction as shown diagrammatically in Fig. 3. Size of plate $3\frac{1}{2}$ in. × $2\frac{1}{2}$ in. Lens of focal length 4 in. approximate. Maximum aperture f. 8 to f. 11. Camera extension, say, 9 in.

I do not intend in this article to give full scale drawings, as I am at present in the process of constructing such a camera in my workshop. When it is completed, perhaps I can persuade the editor to allow me to describe it fully, together with a few examples of what such a camera can accomplish. However, for the benefit of those who wish to design a camera of their own, here are a few points to watch :

The Reversing Back

With this type of camera, it is not practicable to lay it on its side for horizontal pictures. The usual method is to employ a reversing back, this is to say that the part of the back actually carrying the dark slides is made separately and can be clipped to the camera in either a vertical or horizontal position. For this reason the back must be made perfectly square. In designing the near carriage for carrying the back, allowance must be made for drawing the sheath of the dark

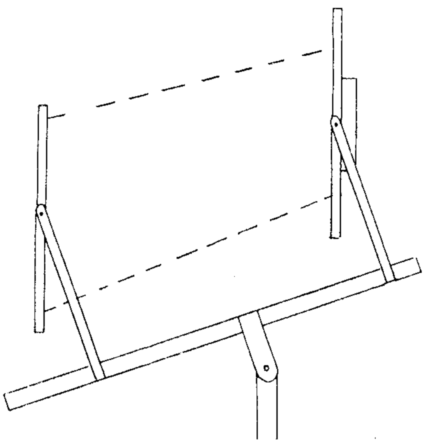


Fig. 5

slide when used in a horizontal position with falling front. Fig. 6 should make this point clear. When using a reversing back on a camera, the bellows are always made with a square cross-section ; as, however, such bellows are not easily obtainable, the ordinary oblong type can be used if, instead of fixing them directly to the lens panel and back, they are secured first to detachable panels which are made reversible on the camera.

Even though one intends to use $3\frac{1}{2}$ in. × $2\frac{1}{2}$ in. plates, it is not a bad idea to make the back of the camera large enough to take $\frac{1}{4}$-plates or 9 × 12 cm. plates. The reason is that, if at some time you want to take a wide angle shot, it is much cheaper to put in a larger plate and use your existing lens, than to buy another lens of shorter focal length. The actual method of fitting the dark slides to the camera will depend a lot on the type of slide one intends using. One can make

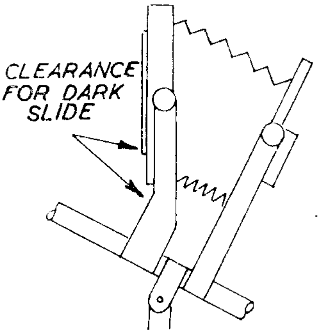


Fig. 6

one's own slides if one wishes, they are not difficult, but I find that commercial slides are not expensive and it is hardly worth while to make them, particularly as in my case when one's spare time is limited. But when single metal slides are used, please take a tip from me and *do not* use a method which entails pushing the slide in grooves over a velvet trap. The force required to push in the slide will often tend to move the camera. Also, the friction imposed on the velvet means that wear is rapid and fog streaks will soon appear on the negative. I myself favour the "quick-change" back which is very popular amongst pressmen. The dark slide is placed in a recess and a hinged flap is closed and clipped shut. A flat spring on the inside of this flap keeps the plate pressed in the focal plane, while a strip of metal forms a lip along one edge to prevent the whole slide being removed when the sheath is drawn. A photograph of such a back appeared in an article of mine published in THE MODEL ENGINEER, dated July 12th, 1951.

With regard to the actual degree of movements required, as far as swings and tilts are concerned the movements offered by this design are more than adequate. You will find, for example, that in actual practice a very small displacement of the lens panel will give quite a large variation in the plane of focus. The rising, falling and cross-front should be sufficient to bring the axis of the lens in line with the edge of the plate. It goes without saying that for ease of operation all movements and adjustments should be smooth and positive.

May I conclude by saying that I hope this article will put any would-be camera constructor on the right lines ; but if there are any points still worrying readers, I shall be only too pleased to try and help if they will write to me c/o the Editor.

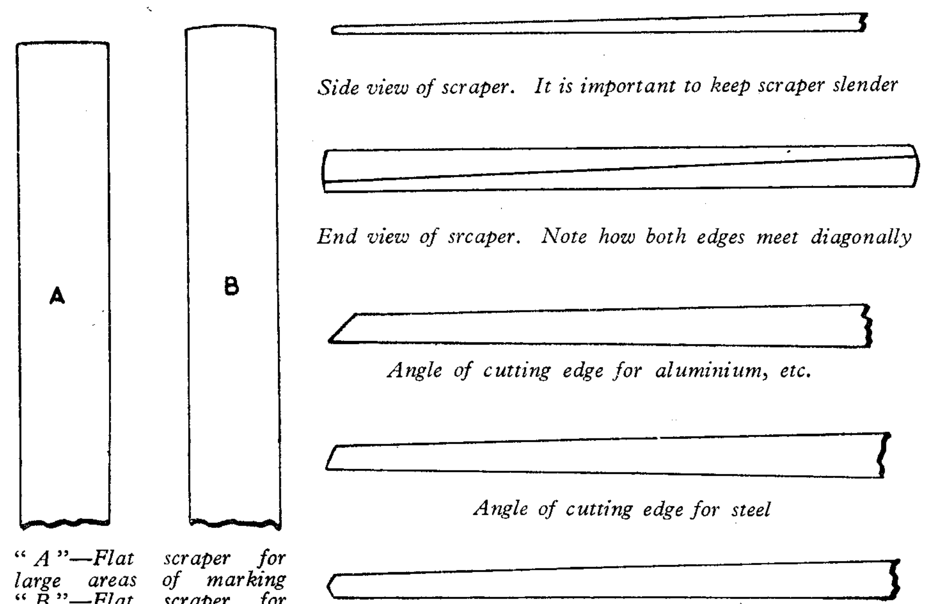
SCRAPING

by A.E.U.

Get your surfaces well scraped, mottled and bedded-in

I BELIEVE that one of the most satisfying sights to an engineer, amateur or professional, is a well scraped surface, whether it be mottled, or just bedded-in without any frills.

The art of scraping depends on two things, practise and having good scrapers (and patience !). Scrapers for flat surfaces should be thin so as to have a certain amount of spring when applied to the surface to be scraped. When a scraper is "just right," it should, when applied firmly to the job, just shave the surface without digging in or chattering. Most commercial scrapers suffer from being too thick, and are unwieldy and dead !



Side view of scraper. It is important to keep scraper slender

End view of srcaper. Note how both edges meet diagonally

Angle of cutting edge for aluminium, etc.

Angle of cutting edge for steel

Double edge for cast-iron and phosphor-bronze

"A"—Flat scraper for large areas of marking "B"—Flat scraper for roughing or small high spots

From Old Files

Most fitters make their scrapers from old files, (usually for two reasons, cost and the fact that a scraper is an individual's tool and is best made by the individual who is to use it). Later in this article I will describe how.

One of the most important parts of a scraper is its cutting edge and the contour of that edge. For finishing work with broad areas of "bed," a scraper with a very nearly straight-edge is best (just how near to straight depends on the individual) ; for roughing out and removing large inaccuracies, a scraper with a fair radius is best. Remember, a straight or nearly so scraper will give a bed with broad areas of marking and shallow depressions in between high spots. A scraper with a fair radius will give a bed with small high spots and rather deep depressions between high spots. This type of bed is best for surfaces that have to act as bearings or machine slides, as it will retain the maximum oil film. Most fitters, however, prefer one (a scraper of course !) between the two extremes.

To scrape a surface we need a "master" of some sort, a surface plate, straight-edge or special "rubbing block," and some form of marking, i.e., prussian blue oil paint (artists), engineers blue (same as prussian blue), printer's ink or red lead mixed with oil and paraffin. Only a very thin film of "marking" should be used. It is best applied to the master with a pad of rag and should be spread evenly and very sparingly, otherwise a false marking will result. If only the centre of the work-piece is marking, scrape away until the marking is only at the edges and then carefully scrape until the marking appears all over, otherwise it is easy to

produce a convex surface that is marking all over! When scraping, the direction of cut should be altered at each marking so as to obviate ripples and to facilitate the removal of high spots.

Accurate Surface

If a really accurate surface is required, when the surface is marked all over continue to rub the job with the master, whereupon the high spots will burnish and appear as highly polished spots; these should be removed very gently until they appear all over the job.

If you cannot obtain a master larger than the piece to be scraped, fair results can be obtained with a straight-edge and a small rubbing block. To check with a straight-edge proceed as follows: Check along the edges of the job with the straight-edge and three pieces of paper (cigarette papers are best), one paper at each end of the straight-edge and one paper to check the gap between the job and the straight-edge. After the edges have been checked, the diagonals should be checked. If all edges and diagonals are correct, the job is flat and requires but little scraping. (Use the rubbing block to find the high spots.)

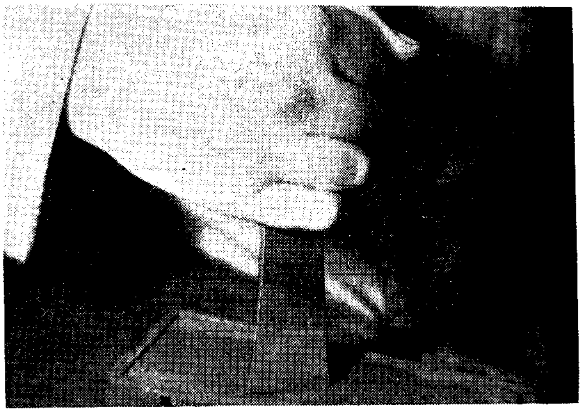
How to Make a Scraper

The best files to make scrapers from are smooth fine files, and for most purposes one about 8 in. long will be quite long enough, but for small surfaces like locomotive cylinder blocks (model ones, of course) files down to 4 in. long will suffice. Smooth files are best because it is easier to remove the teeth marks (do not leave even a trace of the teeth on the part to be rehardened or forged). The marks will cause hardening cracks if not removed. The file should be heated to orange red and beaten out as shown in sketch (do not allow to blister). When satis-satisfactory, cool and grind scraper to finished shape. To reharden the scraper it should be heated to between orange red and cherry red (the heat varies with the brand of file used) and then quenched in water and note! *Not tempered.*

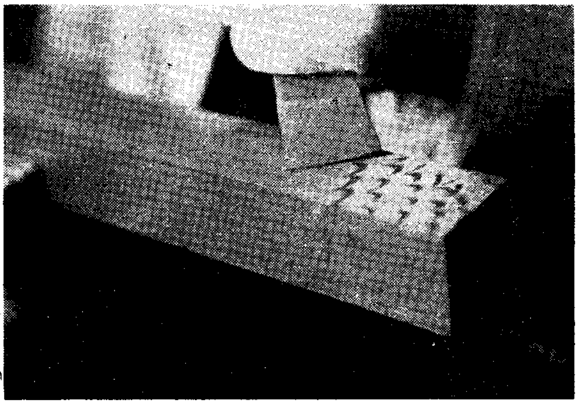
Sharpening

To sharpen the scraper, it should be ground and then stoned. The best stones are Norton India stones. I use a medium grade stone 8 in. × 2 in. × 1 in. (for procedure see photographs), always remembering to stone flats last before using the scraper.

Mottling or feathering are hard to describe with words, and the "way how" is best found by experiment and practice.



First—stone end of scraper. (For iron the scraper should be worked diagonally across stone, dragging the scraper along at the same time)



Mottling

Lastly—Stone flats of scraper (for best results use paraffin on stone)

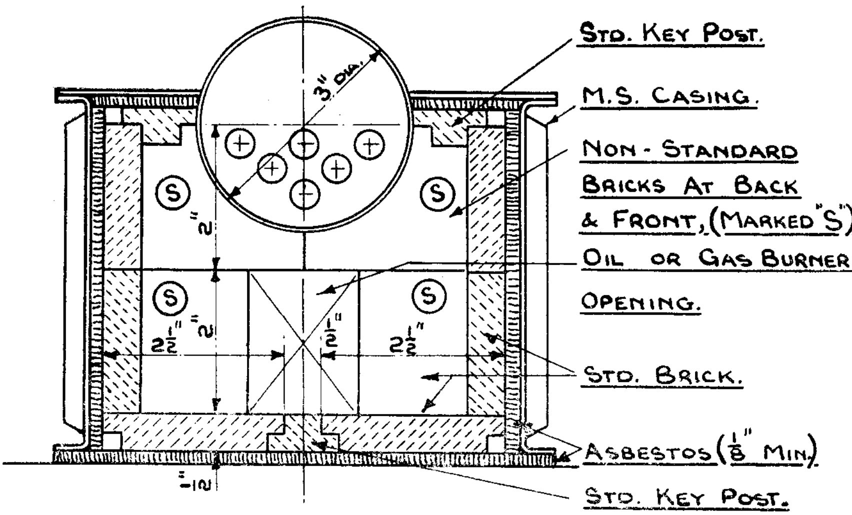
LINE THAT FURNACE!

by A. Goodall, A.M.Inst.B.E.

A LOOK into any modern water-tube boiler furnace, be it large or small, or into the modern equivalent of the old underfired smoke-tube boiler furnace, will convince the model boiler maker that the refractory lining of the furnace is no haphazard job of mere firebricking.

Modern boilers are built inside a steel casing, lined with a thickness of insulating material and a further inner thickness of refractory material to withstand the high furnace temperatures (maybe 3,000 deg. F.) employed nowadays. The during a longish drying period, about which more will be said later.

The accompanying drawings will illustrate the fitting up of the bricks and key posts in the boiler casing, probably better than a lengthy description. It will be seen that the bricks are 2 in. square with a $\frac{1}{4}$ in. rebate at each end for keying, while the key posts are Tee-shape in section. An asbestos lining of at least $\frac{1}{8}$ in. in thickness is used as insulation, and the boiler casing should be fairly stout, say, about 16-sw.g.



Cross section of furnace

insulation keeps the heat in and the steel casing prevents, to a very large degree, air leaking into the furnace and lowering the furnace temperature.

Such benefits can be applied to model boilers. Model boiler casings can be kept comparatively cool, combustion can be improved (especially with coal-burning boilers) and the model boiler can be the "real thing."

The Model Method

The model boiler has its steel casing and probably an asbestos lining, but how to fit a refractory lining which will stay put and improve boiler operation?

A scheme of standard bricks keyed into position by vertical refractory posts, which in turn are bolted to the boiler casing, is put forward. The fitting and moulding of the bricks can be fairly simple, but the success of the scheme depends on the working up of the plastic refractory prior to moulding and the exercise of patience plate, at least if well stiffened with angles at, say, 4 in. pitch, arranged vertically along the casing.

The keyposts should not be bolted on too tightly or they may crack, and the bricks should slide freely into position. This slight slackness of fit will allow them to expand freely as the furnace is heated up.

Making the Moulds

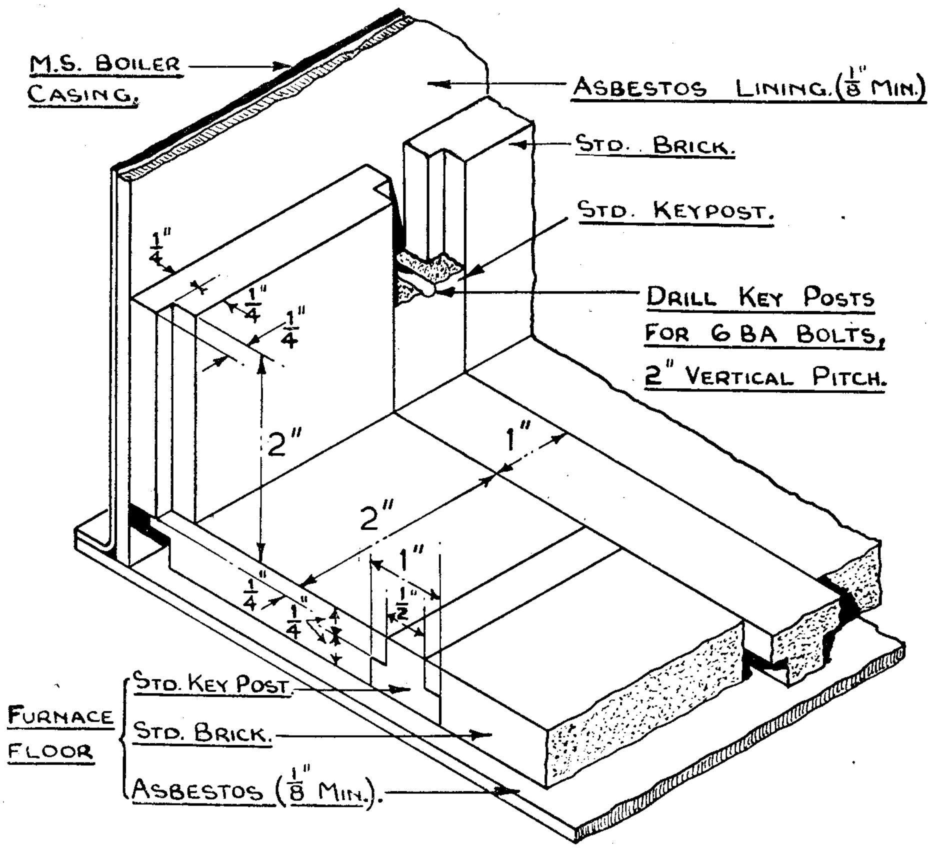
The use of hardwood picture framing of the section shown is proposed. This will save some hardship to metal workers, who feel a bit at sea when working wood. If on the other hand a metal worker really wants to "go to town" he could make his moulds out of mild-steel or brass, but it would be rather a waste of good square section metal unless he intends to go into production on a big scale and start a brickworks! This mould making is akin to pattern making, except that moulding tapers are not required in this case. As each brick is hardened off, the

mould is dismantled from around the brick, and consequently will draw off easily without the use of tapered sides on the mould.

A length of hard wood, say, about 2 ft. long, shaped to the drawing, in section the shape of an "L," and another length also about 2 ft. planed to the section of $\frac{1}{2}$ in. $\times$ $\frac{3}{8}$ in., are required.

The accuracy of the bricks and key posts depends on the care taken to mark off the frame-pieces, and in the squaring up of the ends after cutting, this should be done with a sharp wood chisel.

When screwing up the frames mark off and drill the $\frac{1}{2}$ in. $\times$ $\frac{3}{8}$ in. section pieces to take the



Details of refractory

These pieces will be sufficient to make five moulding frames for the bricks. Twenty No. 6 round-head wood screws $\frac{3}{4}$ in. long are required to fasten up the frames as shown.

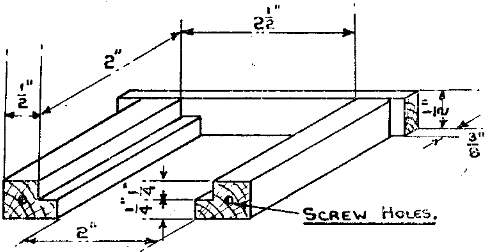
To make the key post moulds, use the same section of wood as required for the sides of the brick moulds, that is the "L" section. It must first be decided how high the furnace walls are to be. Six inches would be suitable for a smallish water-tube or underfired boiler, but it can be decided thus: If the walls are to be two bricks high, the key posts must be 4 in. high; if the walls are three bricks high, then the key posts must be 6 in. high. The "L" section pieces are cut to the length required and the ends of the mould closed off with $\frac{1}{2}$ in. $\times$ $\frac{3}{8}$ in. section hard-wood, as shown in the drawing. Use No. 6 $\times$ $\frac{3}{4}$ in. long wood-screws as before; the wood required and the number of screws will be dependent on the height of wall decided upon.

screws freely, remove any fibres on the hole edges, offer the pieces to the "L" sections and mark off the position the screws will enter. The entry of the screws into the end grain will be assisted if a bradawl hole is made on the mark, and the chance of splitting the wood will be lessened.

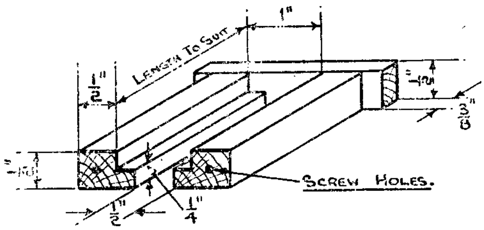
Each time the moulds are re-assembled, a rule should be used to check up the size of brick to be made (and similarly the key post moulds), and then you will be certain that all bricks and key posts will be as near to standard size as possible.

Moulding the Bricks

Having assembled the moulds, the refractory material must now be prepared. Use a good fire clay cement, sold in tins, usually for the purpose of repairing firebacks in the home, and after mixing to a fairly stiff paste (*not* a slurry)



Standard brick mould, with one end removed



Standard key post mould, with one end removed

press it into the moulds firmly, tamping down hard into the corners and making sure there are no hollow pockets or air bubbles in the brick. A level and smooth baseboard is necessary on which to carry out the moulding, as the moulds are open-bottomed.

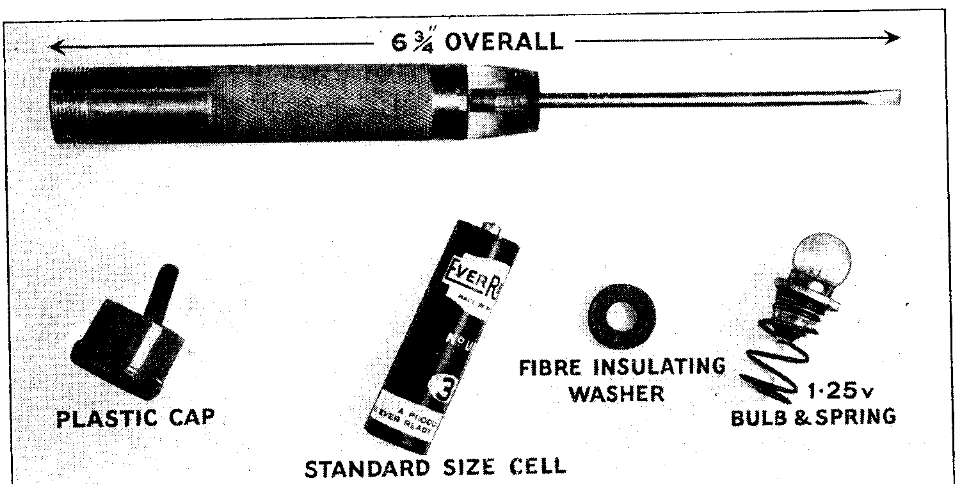
After filling all the available moulds, scrape or "strickle" off the surplus cement, making the bricks flush with the top of the moulds. Then set them aside to *air dry*. Some makers of the fire cements, also suitable for model making, issue a pamphlet on baking the finished moulded articles. Such instructions should be carefully carried out, and not only will satisfactory bricks be obtained, but waiting time will be shortened.

Conclusion

The process is a lengthy one but it is considered worth while, both from an efficiency of performance point of view and for the sake of realism.

The size of brick may be altered to suit the builder's own requirements, the purpose of this article being merely to point out a way and not to dictate a policy; and it is sincerely hoped that it will prove useful to boiler enthusiasts.

THE SPOTLIGHT SCREWDRIVER



ILLUSTRATED here is the Spotlight "Minor" screwdriver, a new product of Messrs. John E. Buck & Co. Ltd., 47, Brewer Street, Piccadilly, London, W.1.

With an $\frac{1}{8}$ in. by $2\frac{7}{8}$ in. blade set firmly in a lens of transparent Diakon plastic, this handy little tool was designed to enable work in dark corners to be carried out with maximum efficiency. The light is operated simply by a turn of the end cap which, when completely unscrewed, allows for easy and rapid replacement of batteries.

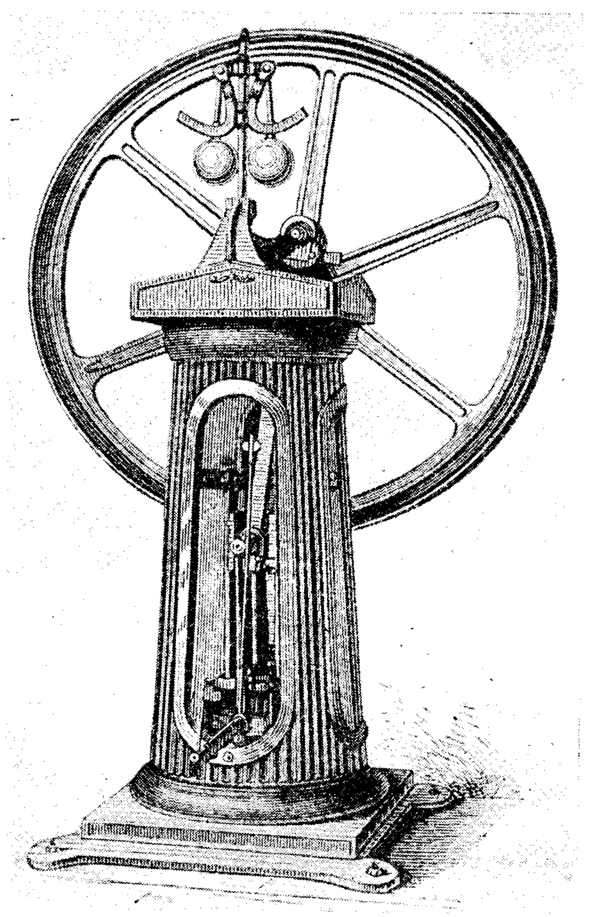
Priced very moderately at 6s. 9d., the Spotlight-Minor will undoubtedly be found useful in a large number of home workshops, and is obtainable from electrical, radio, hardware and departmental stores or direct from the manufacturers, post free.

THAT OLD MODEL STEAM ENGINE

by H. H. Nicholls

THE engine described by Mr. F. P. Lewis in the June 21st issue of THE MODEL ENGINEER, appears to me to suggest the practice of the celebrated old firm of engineers, Easton & Amos, of London ; I was at once reminded of something somewhat similar, driving an hydraulic pump from the crosshead, which is illustrated in that wonderful folio work, *The Britannia and Conway Tubular Bridges*, by D. K. Clark. A copy of this is in the library of the Royal Institute of British Architects, 66, Portland Place, W.1. That engine was made for supplying the hydraulic power to raise the spans of the bridge, for Robert Stephenson, engineer.

It is fortunate that Mr. Lewis was not tempted to remove the governor balls ; their proportions seem quite normal as will be seen in the photograph of a columnar engine of about the same date, reproduced from *The Popular Encyclopaedia* published by Blackie & Son London, Glasgow snd Edinburgh (1874). The writer found in a dealer's shop, paying for it the princely sum of sixpence, a book called *The Steam Engine* by George C. V. Homes, Whitworth Scholar, secretary of the Institution of Naval Architects, Longmans Green & Co., 1900, which, on page 239, shows a governor very similar, and, on page 244, one with crossed arms, and very heavy balls. This author gives complete rules for determining their proportions.



Whether the prototype of the engine shown would be very large is a matter for some doubt ; certainly, the one by Easton & Amos I have referred to is not an enormous affair, but more nearly of the "portable" kind, to permit of its being moved about on the works from place to place. And for this purpose, too, the parts of the model would not be "over scale" ; a good designer probably made the prototype details very strong, as a safeguard against hard work and possible ill-treatment.

The "return connecting-rods" were a feature of many air-compressors made in the U.S.A. ; these had a pair of very heavy flywheels, or balance weights, the double rods being adopted for easy working. An illustration of this will be found in C. Isler's book on *Well Boring for Water, Brine and Oil*, Spon & Chamberlain, New York, and E. & F. N. Spon Ltd., London, edition 1911, on pages 187 and 189.

Mr. Lewis mentions "cast-steel" as a material for slide-bars. Certainly not at the date of his model ; such things came with locomotive practice many years later. Cast-iron was the material then, but, of course, he is right to show the cast-iron ones with ribs.. If, however, the makers of the engine had gone out for an exhibition job, the bars in such a prominent position may have beem wrought-iron, carefully polished. A "spindly" flywheel is all to the good ; the rim is the place for the weight. Certainly Mr. Lewis has had rare luck in finding such a fine old piece of work.

Novices' Corner

Machining and Working Cast-iron

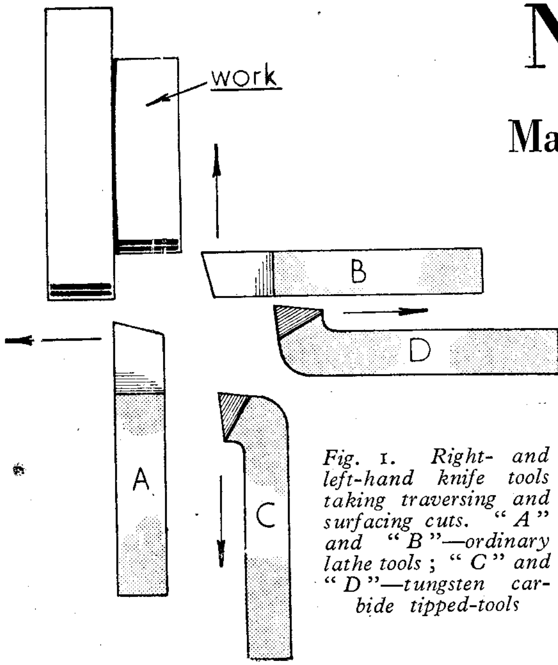


Fig. 1. Right- and left-hand knife tools taking traversing and surfacing cuts. "A" and "B"—ordinary lathe tools; "C" and "D"—tungsten carbide tipped-tools

ORDINARY cast-iron, such as is used for the parts of model engines and machine fittings, is an easy metal to machine if the proper methods are employed.

In the first place, these castings are usually made in a sand mould and, as a consequence, sand grains may be found embedded in the scale that is formed on the surface. As this scale with its sand is highly abrasive, ordinary lathe tools will become quickly blunted when cutting into this outer layer. The usual way of working, therefore, is to make sure that the depth of the initial cut is sufficient to get well through the surface and into the clean metal beneath. This means taking a heavy cut that may overtax a light lathe when a large casting is being machined, but the work will be made easier and the lathe slides will not be damaged by abrasive material if the hard scale is first removed.

This can easily be done by immersing the castings in a pickling bath. For this purpose some 2 oz. of commercial hydrochloric acid is added to about a pint of water in a glass jar, and the castings are allowed to remain in the bath for an hour or so.

The castings are finally washed and scrubbed in several changes of water to remove any loose sand and all trace of acid.

Cutting Speeds

After the work has been mounted in the lathe, the next question that arises is at what speed should the lathe be run, for experience soon shows that ordinary lathe tools are quickly blunted when too high a surface speed is used. Where the tool is cutting properly, a crisp sound of even pitch will be heard, but as soon as the cutting edge of the tool becomes worn and the clearance is lost, this noise almost ceases and the work takes on a burnished appearance due to the rubbing action of the tool. Nowadays, even in the smallest workshops, high-speed tools or cutter bits are generally used for machining iron castings, for this steel not only keeps its edge longer than ordinary tool-steel, but it also enables the cutting speed to be increased.

Cast-iron varies greatly in composition and hardness, but as a rule a surface speed of about 50 ft. per minute can safely be used without high-speed steel tools; however, this speed should be halved when the tools are made of ordinary tool-steel, known as carbon-steel. The lathe should, therefore, be set to run so that a point on the greatest diameter of the work's surface will, when revolving, travel for a distance equal to 50 ft. in one minute. For example, if the casting of a flywheel or chuck backplate is 4 in. in diameter, the circumference will measure approximately 1 ft., and so the lathe should run at 50 revolutions per minute, corresponding, perhaps, to the middle speed obtainable with the backgear engaged. If the lowest speed of the backgear is equal to half this speed, then 8 in. will be the maximum diameter of a casting that can readily be machined when using high-speed steel tools.

Tungsten Carbide Tipped-tools

If a suitable grade of tungsten carbide tool is used the work of machining iron castings will be greatly facilitated. There will then be but little danger of blunting the tool even when cutting into the scale and sand adhering to the surface of the casting, and, more important still, the cutting speed can be increased some five times. This means that the 4 in. dia. work-piece can be run at 250 r.p.m. and the low, direct speed of the lathe can now be employed. Nevertheless, these tools, when taking heavy cuts,

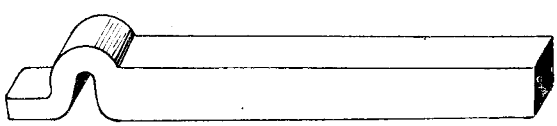


Fig. 2. A form of spring tool for finishing cast-iron

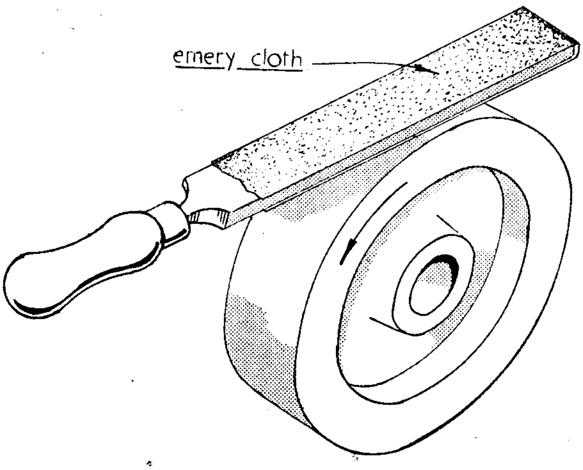


Fig. 3. Polishing the work with emery cloth

finish rather like that obtained by surface grinding.

For the sake of appearance, the rim of a small flywheel, forming part of a model, may have to be highly polished, and, if the preliminary turning is carried out in the way suggested, the subsequent work of finishing will be greatly reduced. However, any tool marks still showing can be removed by applying a worn, fine file to the rotating work, but remember that the carbon-steel file will be quickly blunted if the work is run too fast.

Next, the file marks are moved by applying a strip of abrasive cloth backed by a file or a piece of hard wood. The work can now be run faster and, at the same time, heavy pressure is applied.

The cloth should be well oiled and, as the oil wears off and the surface becomes dry, a fine polish will eventually appear.

require a rigid set-up, so in lathes not of robust construction light cuts should be employed, but owing to the higher turning speed the machining will still be more rapid.

Tool Forms

The ordinary right- and left-hand knife tools will be found quite satisfactory for taking traversing and surfacing cuts respectively, but the tip of the tool should be only slightly rounded, as too great an area of contact with the work is apt to cause chatter. In addition, it is better to use rather less rake than is customary in tools employed for turning steel. The usual forms of boring and screwcutting tools used for steel will also serve for machining cast-iron.

Finishing the Work

Some workers have difficulty in turning cast-iron to a reasonably good finish, largely because a high-speed steel tool, cutting at relatively low speed, tends to open the grain of the metal and leave a surface dotted with black spots. In the past, to overcome this difficulty, various forms of spring tools have been used, and some turners recommend supporting the tool on a piece of leather to assist in preventing chatter. These tools have, in part, a scraping action and, if the clearance is much reduced, a burnishing effect is produced on the work. Although a smooth surface may possibly be obtained in this way, the accuracy of the finished part is liable to be impaired.

A much easier and more accurate method for giving parts a good turned finish is to use a tungsten carbide tipped-tool of a grade suitable for machining cast-iron. With the work running at some 400 to 500 surface feet per minute, a light finishing cut of only a few thousandths of an inch in depth is taken, preferably with the automatic feed engaged. When this method is used, the surface is left with a bright, silvery

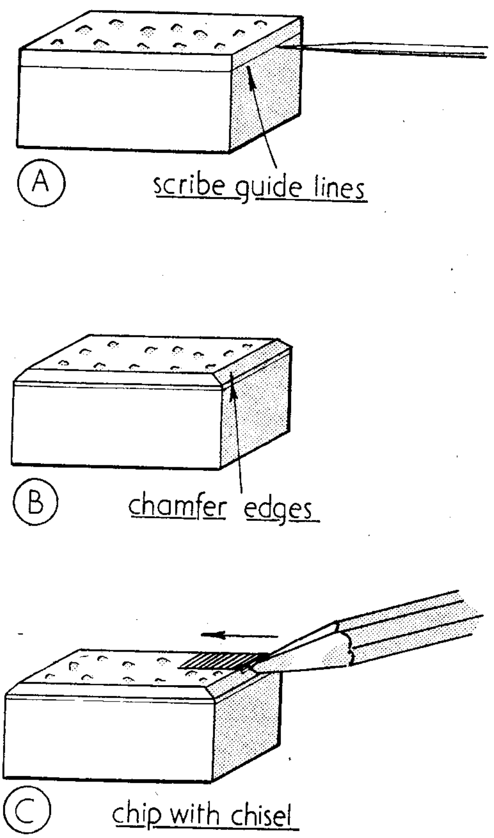


Fig. 4. Preparing the surface of a casting by chipping

Drilling and Spot-facing

When using carbon-steel tools for these operations, it is best not to exceed a surface speed of some 25 ft. per min.; otherwise, if the iron is of the hard variety, the tools may lose their edge. This means that a $\frac{1}{8}$ in. dia. drill or cutter should not be run faster than some 200 r.p.m.; moreover, this relatively low speed will help to prevent chatter and irregular machining.

As in turning operations, the tool should be used without a lubricant, for this would cause the fine chips to clog in the drill flutes or between the teeth of the cutter. When drilling deep holes, raise the drill clear of the work from time to time to clear the chips and keep the drill from jamming in the hole, for many small drills get broken in this way. Holes drilled for tapping should always have their mouths counter-drilled to the clearing size for a short distance; this is in order to stop the surrounding metal being raised when the thread is cut.

Shaping

The ordinary lathe tools can quite well be used in the shaping machine, but if the shaper is of light construction, the area of the tool's contact with the work should be kept small in order to reduce the tendency to chatter. Here, again, the tungsten carbide tipped-tool is of the greatest value, for rough castings can be machined right away without the tool suffering damage from surface sand and scale. Shocks to the tool point should, however, be avoided if possible, as the material forming the tip is rather brittle and is easily fractured by careless treatment.

Chipping Castings

In these days of machine tools being used for almost every purpose and taking the place of hand work, the chipping chisel is seldom used for working up castings. Formerly, large flat surfaces such as the port faces of steam engines were prepared by chipping with a chisel before being finished by filing and hand scraping. However, even now, this process may prove useful at times in the small workshop with limited resources. The work is first placed on a surface plate, when this is possible, and a line indicating the level of the finished surface is then scribed on all sides. Next, the surface of the work is chamfered off with a file as far as the scribed lines. The hammer and chisel are now used to cut away the surplus metal, leaving a small amount to be removed later by filing and scraping. One precaution is, however, necessary: the chisel must never be driven up to the edge of the work, but always away from the edge when nearing the end of the cut, otherwise the edge of the work will probably be broken off.

Once the outer skin has been removed, iron castings can be readily filed and brought to a good finish. An old, worn file is best used for cleaning up the casting, for a serviceable file will be quickly blunted if employed for this purpose.

The backs of half-round files do not, as a rule, get much use and are often in good condition when the flat face has become blunt; the curved surface can, therefore, be put to good use on castings and will serve well to cut through the hard skin so as to expose the good metal below.

If necessary, press down heavily on the file to enable the teeth to cut to the full depth, for if the file is allowed to skid over the work the teeth will be blunted and progress will be slow.

FRIENDLY STEAM

From the many, varied and happy comments on steam, can one trace what really is the root cause of its unquestionable and everlasting popularity?

Is it that we feel that it stood for the age of sanity or when sanity ceased to prevail on this planet, for without question, the advent of the i.c. engine marked the beginning of the era of nightmares, we now all know—of death on the roads, and the making possible of flight and the conquest of the air, even if taking 1,000 h.p. to transport one ton of useful fare paying load?

Motoring and aviation are fine achievements for progress, when serving us and are not our masters, and ease the daily task, but are viewed with horror when out of control as in war, and turned against a defenceless civil population, as we have seen in our recent lives.

Steam was the first really important means that started to take some of the manual effort from work, and the speeding up process started to improve the standard of living.

Steam gave us the first safe, speedy and comfortable travel, by land and sea; in fact, the safest of travel in these or any other spheres, which enables us to see and enjoy our travelling.

We could (and still can) watch with admiration its steady, quiet beat and effort, driving our mills and factories at 90 to 100 r.p.m. Noting with what precision the isochronous governed Corliss or drop valve gears controlled this all-energising fluid, steam, and later in step with progress, develop into the busy bee-like hum of our turbines to give us the handy light and power on tap for all our work.

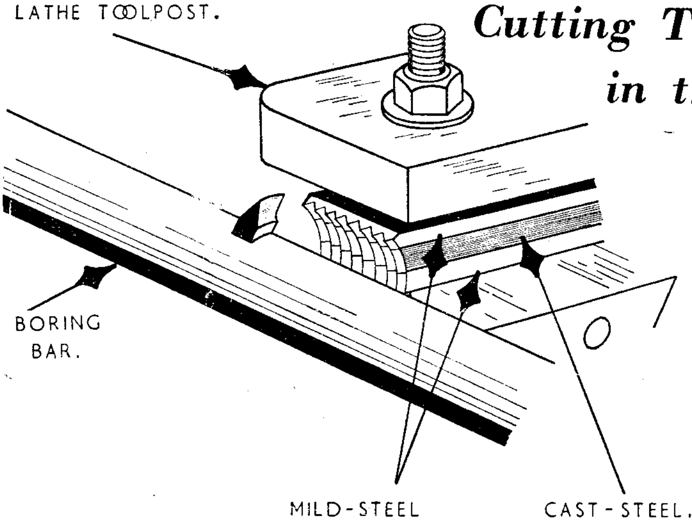
Yes! Something happy, soothing and friendly about steam, restful to the nerves, with no detonation of the i.c. engine, as the roar of a thing at war, with destruction its driving force, energy gone forever—burnt up, destroyed.

Not so steam, which time and again comes round the cycle back to water, and on again for all time and never destroyed, it is with us now as when Watt and Stephenson first harnessed it for our benefit, after being through the gaseous and fluid state an infinite number of times, through the centuries, and will still go on doing this for all time; it is one thing that is indestructible and free.

Yes! it's steam that is friendly and may yet prove to be the best atom in the universe to split, to provide us with unlimited energy.

H_2O contains two all-important elements!—

H. GOODER.

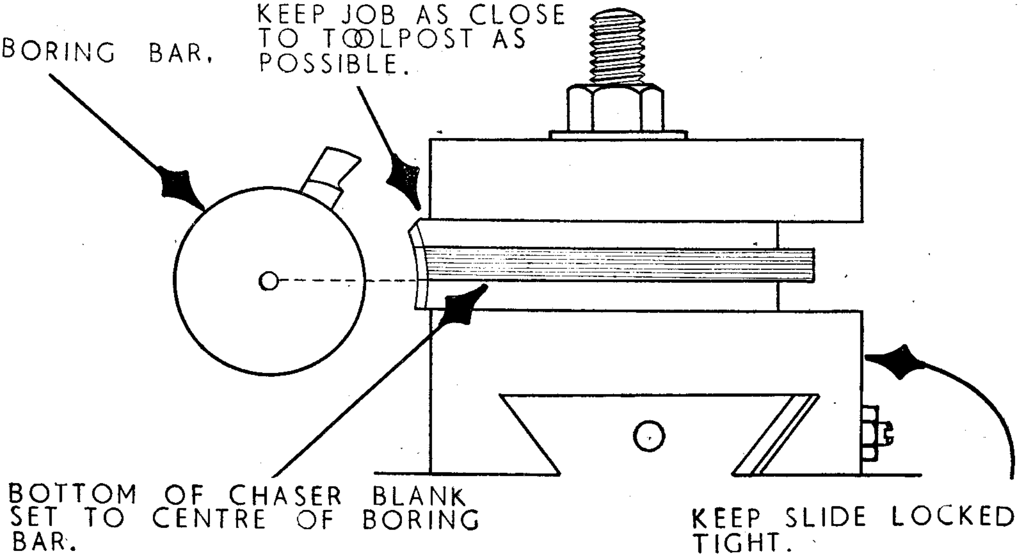


Cutting Thread Chasers in the Lathe

by S. E. Capps

It is not often a thread chaser is needed, but it is useful to have an assortment at hand in case one is required. All the usual pitches can be purchased from the toolshop, but now and again the particular pitch one wants is out of stock. At such times the thread cutting has to be completed without or a chaser made. The writer prefers the latter as, in his opinion, a complement of thread chasers are a worthwhile addition to the lathe equipment. There are many occasions when a chaser is useful in finishing light threads or truing up damaged ones, particularly on internal threaded work that is too light to be held in a vice while a tap is used. Then, of course, there are the jobs that one is not likely to have either taps or dies for such as union nuts, etc. The method adopted by the writer to make his own chasers is shown in the sketches and is well within the skill of the model engineer possessing a lathe.

As will be seen, a piece of suitable tool steel, well annealed, is clamped in the lathe toolpost between two pieces of soft mild-steel. A sturdy boring bar is fitted with a screwcutting tool and mounted between the lathe centres, the lathe change wheels are set up to cut the required thread, and the ends of both mild-steel plates and tool steel screwcut in the usual way. The use of the mild-steel plates is to soften somewhat the jolt of the screwcutting tool and cushion it as it cuts down through the tool steel. The bottom plate tends to stop the bottom of the tool steel breaking away as the tool goes through. It should be understood that light cuts should be used and the full shape of the thread approached gradually. Very accurate and clean threads can be cut in this way, provided the job is not hurried. Hardening of the completed chaser should be carried out as best suits the kind of steel used.



*TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally but very different internally

THINKING about the job the other day, I realised that I had not made recent mention of "Minor." As a matter of fact, there have not been any real deviations from the full specification just lately, because I have been unable to devise anything simpler, and simplicity was to have been the keynote of "Minor."

Even the recently-described pipe system would be hard to alter to any advantage or saving of time in the making, so I think we can forget it; but that doesn't mean that I am in the habit of neglecting builders of the junior locomotive, by any means.

"Twin Sister" No. 2

But here is some news that may interest you. You will remember that Mr. Duncan was heavily engaged in the work of turning out this No. 2 engine, and a grand job he was making of it too. But I noticed that he was lagging behind more than usual, and he seemed to be very tired when he visited me in my workshop on the usual Thursday evening. At last, he told me that working for a newspaper is a particularly heavy job, and entails work at all sorts of hours, day and night, and that he felt he was letting the side down with such poor progress—what were my views?

Well, it is always a difficult job to advise people in cases like these; but eventually a solution was found. A Mr. Edwards, of the Brighton Society, who had been eating his heart out for a real locomotive for almost as long as he could remember, offered to take over the engine—lock, stock and barrel, and the deal was done. So now "Twin Sister" No. 2 has got a new home. The work of completing the locomotive is being resumed forthwith, and I am sure all readers of these notes will wish Mr. Edwards the very best of luck, and so happy steaming days soon.

How Soon?

I thought the mention of that word would cause a few people to sit up and take notice, and doubtless, it must be a question that many builders would like to have answered. For my own part, I hope and, what is more, really believe, that "Twin Sister" No. 1 will be completed before next August. *If* I can continue without undue interruption for the next few months, brushing aside doctors and hospitals meanwhile, then I might still further say that it is "in the bag." If I did not have to draw out all the locomotive parts, bit by bit, and write these notes as well, the engine would have been finished long ago. I hope you appreciate that point.

**Continued from page* 558, "*M.E.*," *October* 25, 1951.

But I take heart in the following; there are quite a few of the locomotives coming along very nicely. I have seen some of them and have met their delighted owners; it looks as though we might be able to muster quite a show in about six months from now, and from that you can draw your own conclusions.

Talking of Cylinders

Some time ago, I told you that there would be some rustless iron cylinder blocks to be had. Well, they're here; about six months late, too. One gets used to trouble in and around any sort of raw materials problem these days, and the cylinders were no exception. To start with, rustless cast-iron contains quite a high percentage of nickel, and this commodity has gone all shy and scarce. As a result, the cylinders supplied have got rather less nickel in them, and that meant that I would have to try them out before allowing builders to spend good money on them. At first, I thought I was due for a big disappointment, because water left on newly-machined surfaces, caused a decided deposit of rust. I wiped it off, somewhat despairingly, and added more water; then the surprise came. No more rust formed! I noticed that the metal turned a bit black after the first rusting but there were no signs of any deep-seated corrosion starting. Since then, tests have been carried further, and there is no doubt at all that the metal has a very decided resistance to rusting, after the preliminary "rash."

One other feature I noticed, and that was the excellent machining qualities of the iron, and great freedom from hard spots and strange cavities hidden in its depths. Altogether, I think it is quite safe to recommend it as a material for small locomotive cylinders. Friend Kennion now has a preliminary batch, and will be pleased to accept orders.

"The Best Hobby in the World"

These are the actual words used by Mr. Bill Cooper, of Canada, in a letter to me lately, and so say all of us! But I would like to add something of my own; it is that small locomotive builders throughout the world, show a greater spirit of helpfulness, one to another, than is found in a great many hobbies.

Here I would like to quote Mr. Cooper's final paragraph :—

"Since writing you recently, I have been fortunate in securing some new copper sheet in 3/32 in. and $\frac{1}{8}$ in. thickness; I would *like to donate this* for one of the 'Sister,' or to some enthusiast. I will shear it to the sizes required on receipt of your advice."

I would mention that the italics are mine; I just *had* to put emphasis on a gesture that is,

unfortunately, far too rare these days. There is a tendency for people to hoard materials for their own needs, never giving a thought to those unfortunates who have only just come into the field, and money or no money, do not have a chance to get going. Well, on behalf of all small locomotive enthusiasts, many thanks, Mr. Cooper, for your generous offer, and we will await developments with interest.

Often, I have been heard to grumble a bit, about the general bulk of my mail. I have to admit that I enjoy all the letters that do not require an answer ; I enjoy the others, of course, but in a different way, knowing that the sender has, in most cases, a definite problem, and that my answer may be only *one* of the solutions offered. But there are times when I feel that I am trying to satisfy two separate and distinct schools of thought. I get letters from those who say, "Never mind how long the job takes—let's have plenty of detail, and *correct* detail at that" ; and then there are others who, although they approve of the design, want to have the engine running in about three months. If I could combine the two features, I would be more than happy. Sometimes, I feel like telling the hurrying types that here they have a locomotive with all the potentialities of a work of art. By this I mean that *any* locomotive built to a complete and exact specification, embodying only good workmanship and a number of carefully-thought-out modifications in order to bring it to a satisfactory working condition, must be of greater value to its builder than a skimped job which, after a few months of building, leaves its constructor wiping his hands, and asking himself "What shall I make now?" If locomotives could be turned out like shelling peas, they would soon become, figuratively speaking, two a penny. What is the average reaction from the man who looks round the local exhibition locomotive section—what stays longest in his memory? The best finished, best proportioned, and, as far as one is able to judge from purely exterior examination, the best made locomotive ; it's natural, isn't it? More often than not, the hallmark of excellence goes right through the job, and the admiration that it has gained is not misplaced.

I don't know how many locomotives I have been shown, or asked to examine, but on literally dozens of occasions, the owners have started the interview with the well-known apology, "Mind you, she's nothing to look at." Perhaps an apology was never intended, but often I have sensed a sort of regret that the builder hadn't taken the trouble to provide a proud and handsome exterior to his otherwise excellent utilitarian machine.

That is why, in the "Twin Sisters" specification, I hope those who finish the job properly will be able to invite anyone to see it run and do its work, turn it upside down, and with the owner's exhortation "Fault that if you can." People may write to me, accusing me of being boastful, too much of an idealist, and the rest of it. The claims I make are *not* for myself ; I know there are plenty of good craftsmen in the world, and all they need is a bit of guidance from somebody who is prepared to scratch out the details for them, and discover the snags before they take charge of the situation. That is my happy position, and although at times it nearly drives me mad, I'm sure it is the job that is badly needed.

Cylinder Drain Cocks

Because I am designing this locomotive for *you* and not myself specifically, I keep running up against problems were I stop to wonder which of two alternatives you would prefer. Very often, there are distinct merits in both cases, and, if it were not for precious time, I would describe *both*, leaving you to take your own choice.

Under the above heading I have met with such a situation. On the prototype, the drain cocks are four separate valves, joined together through a normal system of linkage, and if it were possible to reproduce these to the same scale, they could be made a faithful copy. They would, however, be quite useless for the purpose for which they are intended, but as soon as they are enlarged to become of practical use, the downward projection begins to offend the eye, and one small "likeness" in the engine is destroyed. Returning to full-size practice, the pipes that leave the cocks, turn inwards to the centre of the frames and terminate as a group of four pipes, held by a single, long clip. This led me to the idea of a single drain cock, fitted between the No. 1 and No. 2 stretcher, and to which the four pipes would go in the normal way. The only difference would be in a single main exhaust pipe instead of the four small ones, and I doubt very much if anyone would detect the alteration. The cylinder fittings could be quite small and neat—very much like the real job, and only about half the size of the plug-cock type that I would normally employ. I have considered other well-known types of valves, including the ball valve with its long "ramp" rod to slide along to lift the ball, but even this has a minimum space requirement that leaves little to spare in our case. Perhaps it would be better if I described both systems after all.

If this were the only case of its sort, it wouldn't be too bad. As it happens I have a similar case in the boiler itself ; I have taken a great fancy to the backhead type of regulator, and anyone who has driven a locomotive with one fitted, will know what I mean. I think it is the complete absence of lost motion that makes its handling so pleasant, and at its starting or "pilot" stage, it is a sheer delight. There are other considerations that are of value from the boiler construction point of view, but I won't bother you with these just now.

Forthcoming Attractions

There are not many more jobs to do to complete the chassis, and the drawing of most of the remaining parts is now on the board. I would have included the valve spindle guide bracket this week, but it happens to be on the same large drawing on which I am now working, so you will have to wait for the next instalment. Meanwhile, you can start getting to hand some of the materials needed for running boards, which will be 16-gauge steel. The valance angles will be $\frac{1}{4}$ in. $\times$

$\frac{1}{4}$ in. $\times$ $\frac{1}{16}$ in. brass, but as you will need a considerable quantity of this for inside the side tanks to say nothing of the cab, it might be a good idea to make tentative enquiries forthwith. The same thing goes for half-round brass beading—$\frac{1}{8}$ in. and 3/32 in.; you cannot have too much of this stuff when you get to platework, take my word for it!

And now to deal with late or forgotten queries. The first concerns the brake return springs on the hanger strongbacks. You will remember I told you to drill some small holes in the strongbacks, giving a position for these. If you turn the chassis upside down, you will note that these holes come about in line with the axlebox keep studs. Make up a number of thin brass tabs to put under the heads of the stud-nuts or set-bolts, and let these have portions projecting, with similar small holes drilled in them. These give anchorage for very small tension springs to go between the two parts. I don't think you will need springs at all for the front stretcher, as it has no linkage to flop about to cause drag; at least, it didn't in my case. Keep the springs to about $\frac{1}{8}$ in. diameter for neatness; they will not show at all when the engine is the right way up, and nobody will be offended.

(To be continued)

PRACTICAL LETTERS

Motor Car Repairs

DEAR SIR,—May I write to welcome "Duplex's" article on this subject? Many of us are trying to keep the old bus on the road. The motoring magazines seem to assume that the days of private tinkering are over—so who looks after us?

At the same time may I appeal for more general workshop and how-to-make it articles. I have read THE MODEL ENGINEER for 20 years, and never made a model in my life. It would be interesting to know how many readers, and potential readers, come into this category. My guess is many thousands throughout the country—folk who like making things for the house, the car, the garden, and, of course, the children.

We don't expect THE MODEL ENGINEER to devote a great deal of space to us—but it remains a fact that there is no other paper which treats problems of the workshop and amateur mechanical construction in an adult way.

Yours faithfully,

Caterham J. D. BISDEE.

DEAR SIR,—Regarding the description in your issue of September 20th of a repair to a carburettor float-chamber cover, if the guide hole has worn so much that bushing is required, then the float needle (and the counterweights) will also be worn and require renewal.

It is stated that a worn needle will tend to stick, thereby flooding the carburettor through the float-chamber vent. It is far more probable that flooding would occur if a total clearance of only 0.002 in. between the hole and the needle is given. Drill a hole 1/32 in. larger than the needle, and this will be correct. May I also point out that flooding would normally be from the top of the main jet—not from the float-chamber vent as stated.

A tip for worn counterweights is to reverse them, bringing the flats to the top. This will give a longer useful life.

Yours faithfully,

Wembley Park. S. A. WALTER.

Gas Turbines

DEAR SIR,—I was interested in the letter of your correspondent, Martin Wm. Storey, but more in the source of his information: Rankin Kennedy's six-volume serial book entitled *Modern Engines and Power Generators.* It is at my call, and I consider it ranks high in that class of publication. It is equal to D. K. Clark's *The Steam Engine* of 1890.

Kennedy's book has a wealth of good illustrations of older type machinery, and how great was the prospect of a set of T.B.D. triples, lying in the shops.

The mention of the gas turbine shows that the idea is older than the popular press might suggest, a fact well known to those who take an interest in the progress of prime movers. After all, a turbine is a fluid pressure machine, with the pressure on the blade, and it matters little whether the medium be steam, air or fuel in liquid form. The only drawback was the availability of materials. This is now much better understood.

Engineering for June 9th, 1905, reviews Dr. Stodola's book *Steam Turbines, with an Appendix on Gas Turbines and, the Future of Heat Engines.* This would be about the time of Kennedy's book, while in an earlier issue of *Engineering* Dr. Stodola's experimental vertical gas turbine and generator are well described. A very useful piece of work.

In the same journal, dated November 2nd, 1906, in a review of an article by M. Rey, "Proceedings of the Societe des Ingenieurs Civils de France," a gas turbine and turbine compressor are described. By quoting an extract we have a condition not much improved today, viz.: the relatively large powers absorbed by the compressor, "so that the margin available for doing useful work is almost a vanishing quantity."

It is unlikely that the model maker will take up this attractive power medium, and how much more interesting is a locomotive or power boat installation, as a feast for the eye, one of the greatest appeals of modelling.

Yours faithfully,

Glasgow. JOHN W. SMITH.